BIOLOGY AND CONTROL OF THE MEALY-OAK GALL

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Abstract. Galls are commonly found on urban trees. Induced by oviposition of insects and other arthropods, galls develop from woody tree tissues, forming shelters for developing larvae. Few galls are physiologically harmful to the tree. Some, like the mealy-oak galls on live oak, are not only harmless but may harbor beneficial arthropods long after the gall-maker has departed. Because chemicals will not penetrate the gall, and the activities of the gall-formers are extended over time, the use of chemical pesticides to control gall-making is unreliable. The preferred use of resistant trees is discussed.

Galls are abnormal swellings of plant tissue. In urban areas, the most common galls are those caused by insects. In addition to insects, they can also be induced by specific stimuli received by bacteria, fungi, mites, and nematodes. Most insect galls are physiologically harmless to the host plants. Notable exceptions are those which affect plant growth or fruiting, such as the phylloxera galls.

Among the more than 2,000 American insect-induced galls identified, more than one-third are caused by gall wasps of the family *Cynipidae*, nearly 700 by midges, 80 by aphids or psyllids, and the rest by sawflies, jointworms, beetles, moths, true bugs, and mites (Felt 1940).

The stimulus for gall formation is thought to occur when the female insect oviposits and/or the developing larvae begin to feed, in either case secreting a chemical which affects localized phytohormone activity in the plant. Gall tissue thus is a plant product. The gall grows as the insect develops within, providing food and shelter during the insect's developmental stages.

Many different kinds of insects form galls on trees, with the tree species attacked, the tissue utilized, and the form and color of the gall tending to be distinctive for each species of insect. Some extremes in galls are the huge (50 mm diameter) oak apple gall on red oaks caused by the wasp *Amphibolips confluens,* found usually in May and June on veins or petioles of scarlet, black and Spanish oaks; the horned oak ball (by *Callirhytis cornigera*) on twigs of pin oak in the Southeastern U.S.; and the reddish berry-like galls (*Andricus kingi*) also on diciduous oaks. (See also Johnson and Lyon 1976 for color plates of these galls and their hosts.) Interestingly, among all tree genera, oaks are the most common hosts of gall-inducing insects.

The mention of galls may bring to mind those harmful to plants such as the *Phylloxera* spp. (on pecans, hickory and grapes) and the horned and gouty oak galls (*Callirhytis* spp. wasps common on many American oaks) yet few species actually cause measurable damage. Several, in fact, have been useful to man. Tannic acid extracted from the gall of a Eurasian wasp, *Cynips gallae-tinctoriae,* is used for dying wool. Galls form by *C. theophrastea* were used by the Greeks for lamp fuel. Some types of galls, notably those of *Aylax* sp. on *Salvia pomifera,* are said to be edible. The black gall on deciduous oaks, caused by *Dryocosmus deciduus,* has been fed to livestock in the Midwestern U.S. (Felt 1940).

Case Study: The Mealy-Oak Gall

Since 1971, we have been studying the activities of *Disholcaspis cinerosa* Bass., a cynipid wasp which has two generations annually (a phenomenon called heterogony), each producing a distinctively different gall type on live oak (*Quercus virginiana* and *Q. fusiformis*) in Texas, Oklahoma, and Southeastern Louisiana. One of us (Frankie) has dealt with the biology of the insect and the other (Morgan) its tree host, combining entomological and horticultural interests to provide insight into the insect-tree relationship. In this paper we report our findings which should be of interest to arborists.

The mealy-oak gall is the more visible of the two galls induced by *D. cinerosa.* These galls range from 3-25mm in diameter, and occur in late summer to early fall on live oak branches (Fig. 1). Each

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mealy-oak gall yields a single asexual (parthenogenic) female (Fig. 2) which emerges during the winter. This female, largely unaffected by cold weather, oviposits in the swollen live oak tree buds. From these buds emerges a second gall type, which is beige in color and resembles a kernel of wheat in size and shape (Fig. 3). Adults of both sexes are produced in these galls; each sex is about one-third the size of those of the asexual generation. Immediately following their emergence in March-April, they mate. Males then die, and females oviposit in live oak branches which incudes formation of the mealy-oak gall, thus completing the cycle (Frankie et al. 1977).

Like many other kinds of gall-forming insects, *D. cinerosa* are highly host-specific, occurring only on the live oak species. Where these trees are planted in urban areas of Texas, several distinctive patterns of infestations can be easily observed. First, only about 1 in 16 trees shows significant susceptibility to the insect, yet occasional trees produce extremely large numbers — up to 10,000 per tree. Most, however, produce moderate to low numbers, and a few have no galls. Second, individual trees within most plantings represent a mixture of infestation levels. Third, relatively non-susceptible trees maintain their state of infestation, even in close proximity to susceptible trees; and, finally, the capacity to form galls apparently diminishes through time in susceptible trees. Thus the homeowner and ar-

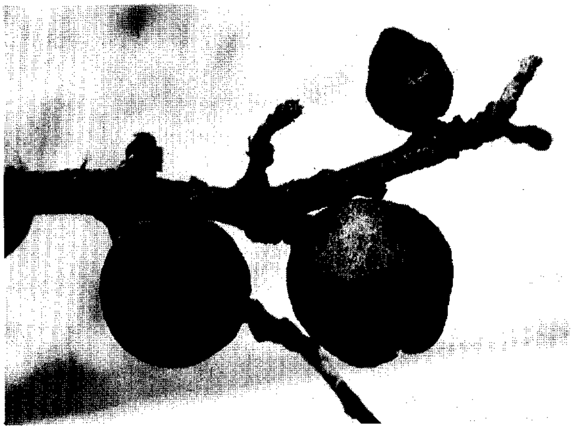

Fig. 1. The ruddy-appearing mealy-oak galls may persist on the limbs of a live oak tree for several years, harboring beneficial insects and spiders.

Fig. 2. A female *D. cinerosa* of the asexual (parthenogenic) generation seeks out swollen buds in which to oviposit.

Fig. 3. Sexual generaton adult *D. cinerosa* emerge in spring from the beige, wheat kernel-size gall formed on the buds of the live oak in Texas, Oklahoma, and Louisiana.

borist who find that the presence of the galls detracts from the natural beauty of a tree may discover a means of control over time: as the tree ages, it may gradually lose its susceptibility.

Some interesting phenomena are associated with these insects and galls:

The mealy-oak gall (and the smaller, alternate gall as well) apparently are harmless to the tree host, causing no apparent or measurable plant dwarfing, leaf abscission, or limb breakage (Morgan et al. 1982).

The mealy-oak gall serves a beneficial role in the general health of the tree. In the 4-5 year interim between the time when the wasp emerges and the (old) gall finally falls from the tree, the gall becomes a dwelling place for predatory insects and spiders which attack aphids and other tree pests.

Where trees are located in a natural setting, the gallmakers generally are heavily parasitized (up to 97%) by several species of small parasitic wasps. In shopping centers and other urban sites, however, trees may produce large numbers of galls for several years until the natural enemies appear and bring the galls under control (Frankie, unpublished observations).

Over time, those trees that initially were susceptible lose that "susceptibility" as physiological resistance may develop and the gall wasp's natural enemies appear. Yet during a tree's more prolific gall-producing years, it may "cycle" up and down in gall numbers, producing an abundance of galls one year, few the following year, and vice versa.

Stress conditions which stunt tree growth apparently have no influence on gall production. There was no apparent correlation found between gall production and transplanting shock of the root system, drought, freeze, heavy rainfall, fertility, or fruiting.

Chemical control attempts have been unreliable, perhaps even counter-productive. Adult asexual female emergence in late November through January from the mealy-oak galls is too protracted to make it feasible to expect to effect control of them with a single spray application. Similarly, the sexual generation emerges over a 4- to 6-week period in the early spring. Chemicals do not penetrate woody tissue; once gall tissue begins to form, it is impractical to halt growth with currently known pesticides. Further, it is likely that chemical insecticides would destroy parasitic wasps which eventually may provide long-term control. Thus, the informed arborist should consider avoiding the use of chemicals in the vicinity of an affected tree, instead allowing the tree time for the development of its natural resistance and the attraction of parasites to the gall-making insect. Eventually, the "susceptible" tree may become "resistant." In the meantime, the offending galls may be hand-picked or knocked from the tree limbs, especially from smaller trees.

Finally, the most effective means of control may be in selecting inherently gall-free trees (Morgan et al. 1978). Improved production techniques have made it feasible to propagate the live oak asexually (Morgan et al. 1980), and for the last three years we have been producing "resistant" and "susceptible" clones of those trees used in our study. As commercial nurserymen continue to accept these propagation procedures, we expect that resistant trees will eventually be offered to the public.

There remains a great deal to be learned about resistance to gall formation. Practical questions evolve: What specific mechanisms are involved in resistance? Are gall-inducers chemically attracted to susceptible trees? What elements (chemicals or otherwise) are present — or missing — in resistant trees? What is (are) the factor(s) in tree aging that influences gall formation? Can susceptible trees be manipulated at an earlier stage of growth? Why do adjacent trees react differently? These questions deserve further attention in the laboratory and in the field. Scientists, and arborists, need a clearer understanding of gall-tree relationships.

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ABSTRACT

Chapman, Douglas J. 1982. **Pruning: a key to integrated plant management.** Weeds, Trees & Turf 21(1): 52, 54, 58.

To more knowledgeably make pruning decisions, one should understand how a tree grows, its gross anatomy, and the tree's response. Trees have essentially two growth centers or meristems. They are the terminal meristem and the lateral meristem (cambium), located just beneath the bark. These two growth centers are involved with increasing the plant's height (terminal growth) and stem diameter (lateral growth). The center (heartwood) of branches and/or the trunk are nonliving with the main function being support. It is important to remember that pruning results in the removal of undesirable plant parts but also inflicts a wound. Wounds to trees and shrubs are defined here as any break in the continuity of the outer protective bark which penetrates into the living tissue or deeper. The tree's response to pruning wounds is isolation of the wound and then callus closure. Pruning objectives for young, vigorous trees include the culture of healthy, disease-free, symmetrical plants. The following rules help achieve these goals: start pruning trees when young, maintain a central leader, eliminate narrow v-crotches, remove dead and diseased branches, eliminate insect-infested branches, remove rubbing or deformed branches, and select well-spaced, broad-angled scaffold branches.