# Kermes Scales (Hemiptera: Kermesidae) on Oaks

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**INTRODUCTION:** Kermes scales, or gall-like scales (Hemiptera: Kermesidae), occur as pests of oaks (*Quercus* spp.) throughout the northern hemisphere. Kermes scales feed by drawing sap from the twigs (and sometimes leaves or petioles) of their hosts, which can result in growth loss, branch dieback, leaf distortion, and the accumulation of sooty mold fungi. In North America and Mexico, there are 32 species of Kermesidae in five genera, but in northeastern North America, there are nine species in four genera (*Eriokermes, Nanokermes, Allokermes,* and *Kermes*) (Bullington and Kosztarab 1985). There are five *Allokermes* spp. in Florida: *A. cueroensis* (Cockerell), *A. galliformis* (Riley), *A. gillettei* (Cockerell), *A. kingii* (Cockerell), and *A. kosztarabi* (Baer). Of these, only *A. cueroensis*, *A. galliformis* and *A. kingii* are of economic importance.

**IDENTIFICATION: Crawlers:** First instars or "crawlers" of *Allokermes* spp. are minute (0.4 mm long), oblong, salmon-colored and wingless with well-developed legs and antennae (Fig. 1). **Males:** Second instar males cover themselves with a white waxy test (Fig. 2) on the tree stem. Adult males (Fig. 3) are gnat-like, about 1.0 mm long, red to light brown and have fragile wings and slender well-developed legs. The poorly-developed mouthparts are non-functional. **Females:** Second instar females produce a waxy coat that covers their bodies. As the female scale matures it becomes more bulbous and darker with much-reduced legs and antennae, making it hard to distinguish from a gall or axillary bud cover. To properly identify *Allokermes* spp., young adult females should be slide-mounted and examined with a binocular compound microscope (up to 400X). In the field, females of the following three species may be identified by color, body size, and distinguishing marks on tergum (dorsal section of the insect):

*Allokermes cueroensis* is large (8 mm in diameter) and convex with no median constriction, brownish-white and marbled with a very pale grey. The tergum has linear brown bands that are somewhat wavy and thickened at intervals and is speckled with minute brown spots (Kosztarab 1996).

*Allokermes galliformis* is subspherical with an average diameter of 5 mm. It is pale yellow with minute and evenly speckled brown dots mottled with grey, and has a polished and smooth appearance. The upper most part of the tergum has about seven irregular rows of black dots (often connected by an irregular black line) separated by white or pale yellow bands (Kosztarab 1996). The three uppermost rows are most distinct and constant (Figs. 4-5).

*Allokermes kingii* is very convex, with bulging sides, measuring about 5 mm long, 4 mm wide and 3.5 mm dorsoventrally. The tergum is pale brownish-yellow and marbled with a slightly darker, redder tint. The marbling is absent in the mid-dorsal line, leaving a longitudinal pale band. Transverse rows of small black spots cover the entire surface. Overall, rounded evenly dorsally, without depressions (Kosztarab 1996) (Figs. 6-7).

**DISTRIBUTION:** Kermes scales occur in Africa, Asia, Europe and North America. *Allokermes* spp. are native to North America and also occur in Canada and Mexico. *Allokermes kingii* occurs in 32 states in the U.S., and is largely absent in the western states (Scalenet 2004). *Allokermes kingii* has been reported in five counties in Florida, including Alachua, Gilchrist, Hendry, Pinellas and Polk counties.

**HOST PLANTS:** All records of *Allokermes* spp. infestations are reported from *Quercus* spp., except for one record on *Castanopsis* sp. in California (Ferris 1955) and *Juniperus* sp. Five host species occur in Florida: *Q. geminata* Small, *Q. laurifolia* Michaux, *Q. phellos* L., *Q. velutina* Lamarck and *Q. virginiana* Miller. Other hosts include *Q. coccinea* Muenchhausen, *Q. ilicifolia* Wangenheim, *Q. imbricaria* Michaux, and *Q. rubra* L. (Stein *et al*. 2003).

**ECONOMIC IMPORTANCE:** Kermes scales directly affect plant growth by penetrating the host phloem with their stylets and feeding on the sap (Raven 1983; Vranjic 1997). In general, populations of most native scale species (including *Allokermes* spp.) are effectively controlled by natural enemies, weather, and other environmental factors. They rarely reach pest thresholds in

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**Figs. 1-8.** 1) *A. kingii* crawlers in brood chamber. 2) Male test of *A. kingii*. 3) Adult male, *A. kingii*. 4) Second instar, *A. galliformis.* 5) Adult *A. galliformis* tended by ant. 6) Second instar *A. kingii* on tree branch. 7) Adult female, *A. kingii*. 8) Damage caused by *A. kingii* on *Quercus* sp. (Photography credit: Figs. 1,4,5,7, Lyle Buss, University of Florida; Fig. 3, Jerry Butler, University of Florida; Figs. 2,6,8, Jay Cee Turner, University of Florida)

natural ecosystems. Periodic infestations and outbreaks of Kermes scales are primarily a concern in nurseries or on ornamental trees in urban and residential landscapes. Often, impact is primarily aesthetic. Infestations may result in branch dieback (Fig. 8), reduced tree growth rates, leaf distortion and sooty mold, which grows on the honeydew secreted by the scales (Vranjic 1997). Tree mortality is rare, but may occur during heavy infestations. In Florida, Kermes scales were a persistent problem on urban oaks in the Tampa/Clearwater area between 1990 and 2002.

**BIOLOGY:** Among *Allokermes* spp., only the biology of *A. kingii* has been studied and published to date. Hamon *et al.* (1976) reported that *A. kingii* had one generation per year in Blacksburg, Virginia. In Clearwater, Florida, *A. kingii* has two generations per year (Turner 2004). In the Florida population, *A. kingii* eggs are laid within the brood chamber (the space between the "false venter" and the "true venter" or sternum) in April and hatch in mid-May. Each female lays an average of 3,000 eggs (Hamon *et al.*

1975). First instar females molt into second instars in July, and after a short third instar become adults by late August. A second generation of *A. kingii* begins to emerge by mid-September. Some of the first instars of the second generation molt into second instars by mid-October. Scales overwinter as first and second instars on branches and in the crevices of the tree stem. Female nymphs become active in February and migrate to leaf petioles and tree wounds. At this time, male scales migrate further down the tree stem. First instar females of the second generation molt into second and third instars and become adults by April.

The life cycle of male *A. kingii* has not been studied extensively. Sexual dimorphism occurs in *A. kingii* beginning in the second instar when males migrate further down the tree stem, settle in bark crevices, and cover themselves with a white, waxy, felt-like test. Males stop feeding and go through pre-pupal and pupal stages. Adult males begin to emerge in late September. The adult male has non-functioning mouthparts and lives for a few hours to a week.

Adult females are neotenic, which is a prolonged larval form in a sexually mature organism. Because *A. kingii* females are neotenous, they are able to mate with males at a young age (Gullan and Kosztarab 1997). The lumen of the adult male contains numerous sperm bundles in a liquid surrounded by a sheath (Foldi 1997; Gullan and Kosztarab 1997). Females store the sperm bundles in their oviducts. If a male mates with a teneral female, fertilization may be delayed until the eggs are mature (Gullan and Kosztarab 1997).

**CONTROL:** Mechanical management by pruning or removing scales by hand and destroying infested plant material may help minimize infestations. Control with insecticides is usually most effective against first instars or crawlers, but overlapping generations and an extended crawler activity period complicate control timing. Monitoring is important to determine appropriate time of chemical application (April-May, August-September), and may be easiest by collecting female scales to see if the eggs have hatched. Wrapping sticky tape around infested branches and periodically examining the tape for nymphs also may be useful. Applications of horticultural oil when the air temperature is less than 90°F may suffocate any scale life stage. However, unrefined horticultural oil may burn leaves if applied at hotter temperatures. Oils lack residual efficacy, so repeated applications may be necessary. At the time of this publication, several insecticides were labeled for contact or systemic control of scales. Consult your local cooperative extension service office for current legal insecticide recommendations.

Several natural enemies attack *Allokermes* spp., including ladybird beetles, lacewings, predaceous moth larvae in the families Blactobasidae, Cosmopterigidae, Pyralidae and Scelionidae, and parasitoids in the families Encyrtidae, and Mymaridae. Populations of scales and other sapsucking insect pests can increase when their natural enemies are inadvertently killed by broad-spectrum insecticides (Coulson and Witter 1984), thus widespread or repeated use of such compounds should be approached judiciously. A Kermes scale outbreak at Fort De Soto Park, Florida, circa 1976, occurred in association with insecticide fogging for mosquito control (Avas Hamon, personal communication), a practice that has been implicated as causal to other scale outbreaks due to elimination of natural enemies (Luck and Dahlsten 1975).

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