The Insect Fauna on Southern Magnolia *(Magnolia grandiflora)*

P. L. Lambdin[1], J. F. Grant[1], and C. T. Werle[2]
[1]Dept. Entomology & Plant Pathology, University of Tennessee, Knoxville, TN 37996.
[2]USDA/ARS, Small Fruits and Ornamentals, Poplarville, MS 39470.

Some of the most beautiful woody plants in the southeastern United States are the magnolias, which are known for their large, fragrant, white flowers, magnificent foliage, and primitive fruit. In the southern hardwood forests, magnolias are considered indicator plants for forest health with Bigleaf Magnolia *(Magnolia macrophylla)* and Fraser magnolia *(Magnolia fraseri)* considered important in Appalachian Cove forests.

Figure 1. Southern Magnolia planted in an ornamental landscape.

Southern or Bull Bay Magnolia *(Magnolia grandiflora)*, one of seven members of the magnolia family found in Tennessee, is the most recognized member of the *Magnolia* genus found in the southeastern United States. The distinctive, fleshy, cone-like seed case that splits along the outer edges releas-

ing bright red seeds and the densely-branched growth pattern with year-round leaf cover provide food and shelter for many types of birds and small mammals (Halls 1977). In addition to their presence in natural forest areas, magnolias are commonly grown as ornamentals and often planted as focal plants in landscapes (Figure 1).

Although its natural distribution is now limited to forests primarily from the southeastern coastal plain from North Carolina to eastern Texas, it is used as an ornamental in urban settings from New York to southern California. The dark green leaves complement the red berries in centerpieces and door hangings in holiday decorations. While this species grows best in rich soils, it occurs in a wide variety of habitats ranging from shady, well-drained sites to flood plain woodland and coastal dune sites, as well as swampy regions, drought-stricken areas, and in conditions of high heat or wind. The historic Southern Magnolia planted at the White House by President Andrew Jackson has survived Hurricane Andrew in 1992, an airplane crash on the grounds of the White House in 1994, and other environmental constraints over the years, and remains the oldest tree on the White House grounds. This magnificent tree is prominently featured on the backside of the United States 1928–1995 series twenty-dollar bill. [See *Magnolia*, Issue 68 —Ed.] In addition, the magnolia flower was adopted as the state flower of Louisiana in 1900. Mississippi, the "Magnolia State," adopted the Southern Magnolia as the state tree and flower in 1938, and 1952, respectively (Grimm 1967).

Many different kinds of insects (such as bees, butterflies, moths, true bugs, and beetles) may be found on a magnolia tree throughout its lifetime. These include insects that may damage the tree (such as defoliators, sap feeders, flower feeders, borers, root feeders, etc.), those that may provide benefit (such as pollinators or predators that feed on pest insects), or those that may be incidental (such as insects using the foliage as shelter, transient species, etc.). Although rarely threatened by pest insects in the southeastern United States, a few insect species may damage Southern Magnolia. Baker (1972) listed 18 pest species, half of which are scale insects, associated with the Southern Magnolia in the United States. Scale insects are some of the most harmful organisms, as they damage the tree by extracting large quantities of sap; scale insects also produce honeydew that covers the leaves and serves

as a substrate for the growth of sooty mold. This fungal growth inhibits photosynthesis and affects the health of the tree. Scale insects feed on leaves, stems, and branches, with heavy infestations causing chlorotic spots and premature leaf drop (Kosztarab 1996). Scales found on magnolia include the magnolia white scale, *Pseudaulacaspis cockerelli* (Cooley) (Leibee and Savage 1994), the magnolia scale, *Neolecanium cornuparvum* (Thro) (Herms 2003), tuliptree scale, *Toumyella liriodendri* (Gmelin), and Chinese wax scale, *Ceroplastes ceriferus* (Williams and Kosztarab 1972).

Other insect species also have a close relationship with magnolia. For example, several species live in the leaf litter of magnolia (Wheeler and Stimmel 1998), and magnolia is the only known breeding host for the leaf-footed bug, *Leptoglossus fulvicornis* (Mead 1971, Wheeler and Miller 1990, Mitchell and Mitchell 1983). In addition, environmental stresses may weaken Southern Magnolias and increase their susceptibility to insect pests, such as bark tunnelers, borers, root feeders, etc.

A better understanding of the relationship between insect species and magnolia health would enable homeowners, foresters, and nursery growers to improve management of magnolia. Unfortunately, no comprehensive assessment of the insect fauna associated with Southern Magnolia in the southeastern United States has been conducted. Thus, the objective of this research was to assess the richness and abundance of insect species associated with Southern Magnolia in eastern Tennessee.

Methodology

We evaluated the insect fauna on two mature Southern Magnolia trees [29.5 and 44.3ft (9.0 and 13.5m) tall] in a mixed hardwood forest site (University of Tennessee Forestry Experiment Station and Arboretum, Anderson County, TN) and on two mature trees [45.9 and 49.2ft (14.0 and 15.0m) tall] in an urban site (University of Tennessee Agriculture Campus, Knox County, TN). Because of the differences in behaviors and biologies among insect species, various sampling methods including Malaise/pan traps (collected every two weeks from the upper 1/3 and lower 1/3 of tree canopy), pitfall traps (monthly), direct sampling with sweep nets (weekly), and canopy fogging (two trees monthly at the forest site using a standard broad-spectrum, synthetic pyrethrum insecticide dispersed by a modified Dynafog Golden Eagle™ fogger) were

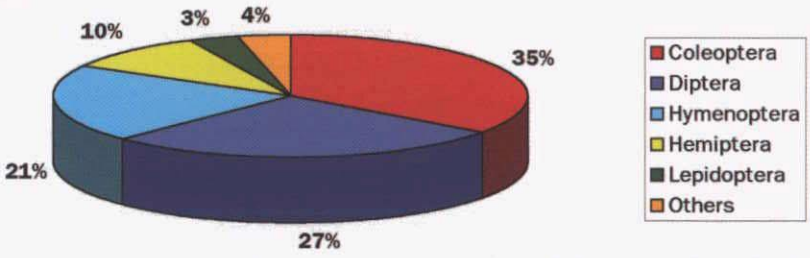

Figure 2. Composition of insect groups collected on Southern Magnolia in eastern Tennessee, 2001 and 2002 (n=476 insect species collected).

used to collect insects from April through November 2001. More detailed information on sampling can be found in Werle (2002). Also, insects from five flowers on each of two trees at the urban site were sampled three days each week for 30 minutes per tree from 21 May to 18 July 2001 using a sweep net. From 12 May to 29 June 2002, we included Tangle-trap® sprayed onto the tepal surfaces of five flowers per tree along with sweep-net sampling. Flowers were examined after 24 hours; collected insects were labeled, taken to the laboratory, and processed. Pollen grains were examined on the insect bodies, removed from infested insects, and measured using a variable pressure scanning electron microscope and a Leitz microscope.

Results and Discussion

The Southern Magnolia provided food, shelter, refuge, and protection for a multitude of insect species. In this study, we collected 476 insect species, representing 127 families and 11 orders, from Southern Magnolia. Various guilds, such as predators, scavengers, bark tunnelers, and wood borers, as well as plant, pollen, and fungus feeders, were documented. Fortunately, few of these insect species cause serious harm to Southern Magnolia. In fact, 285 species were represented by only one or two specimens, suggesting that they may not be closely associated with Southern Magnolia. Most of these species are known to be primary or secondary feeders on host plants other than Southern Magnolia.

Figure 3. Japanese beetle feeding on flower of Southern Magnolia.

While more specimens (ca. 2×) of a species were found at the urban site, more species were documented from the forest site. Also, significantly more insect specimens were collected from the upper canopies than from the lower canopies using malaise traps. The insect fauna collected from malaise traps was more diverse and even in distribution than the ground-dwelling insects collected from the pit fall traps. Several insect species, however, represent potential economic pests, while other species are important beneficial agents. Species of insects within the orders Coleoptera (179), Diptera (141), and Hymenoptera (106), respectively, dominated the insect fauna collected from Southern Magnolia (Figure 2).

Several types of beetles may damage Southern Magnolia. These include the leaf beetles *(Chrysomelidae)*, weevils *(Curculionidae)*, sap beetles *(Nitidulidae)*, scarab beetles *(Scarabaeidae)*, and bark beetles *(Scolytidae)*. Six exotic beetles, including the Asiatic oak weevil, *Cyrtepistomus castaneus*, the clover leaf weevil, *Hypera punctata*, *Mecinus pyraster*, the whitefringed beetle, *Naupactus leucoloma*, the scarab *Onthophagus nuchicornis*, and the Japanese beetle, *Popillia japonica*, were recorded from Southern Magnolia. The Japanese beetle, which can feed on the flower, fruit, and foliage of more than 300 ornamental and agricultural plants, including Southern Magnolia, is perhaps the most important pest species collected. Japanese beetles were commonly found in the urban

Figure 4. Pollen granules of Southern Magnolia adhering to body and setae of honeybee.

site (85 specimens collected, 84 from flowers), and rarely found (only one specimen) on Southern Magnolia in the forest.

Two sap beetle species, *Glischrochilus fasciatus* and *G. sanguinolentus*, are primary vectors of the pathogen, *Ceratocystis fagacearum*, that causes oak wilt, a disease threatening native oaks across the midwestern United States. These sap beetles are attracted to the flowers of Southern Magnolia. Both species were abundant at the forest site, and given the importance of oaks to the forest ecosystem, may represent a problematic species if this disease spreads into eastern Tennessee.

Several beneficial beetle species, including the ground beetles, lady beetles (*Coccinellidae*), scarab beetles, and soldier beetles (*Cantharidae*), also were collected. The soldier beetle, *Chauliognathus marginatus*, has been reported as a biological control agent of various pest insects, including corn rootworms (*Diabrotica* spp.). Of the 61 total specimens collected, 49 were collected by sweep net from flowers. It is also an important pollinator of several flowering plants and may fill this role on Southern Magnolia. A ground beetle, *Abacidus atratus*, was the most abundant beetle collected in pitfall traps, and was second in overall abundance only to the Japanese beetle. This ground beetle is an effective predator of pests such as scarab grubs and an important biological control agent in agricultural fields.

Two exotic lady beetle species were commonly collected from Southern Magnolia. The sevenspotted lady beetle, *Coccinella septempunctata*, of European origin was introduced into the United States in the early 1970s and is an effective predator of aphids throughout the eastern United States. Another coccinellid, the multicolored Asian lady beetle, *Harmonia axyridis*, was introduced from Asia to control aphid pests in forests. This lady beetle is occasionally considered a minor pest in some areas due to its behavior of invading and hibernating in homes during winter months. These two lady beetle species were usually collected from the same samples.

The exotic scarab, *Onthophagus nuchicornis*, known from Europe and central Asia, was introduced into North America around 1945 as a biological control agent. This species breaks down cow and horse dung, effectively reducing populations of horn fly, a medically important livestock pest. This species was represented

by one specimen collected in a pit fall trap at the forest site. The cerambycid *Strangalia luteicornis* is widespread throughout the eastern United States, where it is commonly found on flowers and foliage. It also has been noted as an important pollinator of *M. grandiflora* (Thien 1974). Although this cerambycid was not collected in our floral sampling at the urban site, 18 specimens were collected from malaise traps at the forest site.

Magnolia flowers were often visited by insects. During 2000 and 2001, 44 insect species, representing 29 families and 7 orders, were collected from magnolia flowers. Overall, the most frequent floral visitors were the Japanese beetle (34.3%), honey bee, *Apis mellifera* (19.9%), and soldier beetle (19.5%). During early sampling, the most abundant species (36%) collected from the flowers was the honeybee. Later, Japanese beetles (58%) became the dominant floral visitor (Figure 3). Japanese beetles fed on pollen and flower tepals, with as many as 12 beetles on a single flower. Damage to the flowers from feeding by large numbers of Japanese beetles resulted in irregular holes in the lipid tissues of the petals. This exotic pest not only affects the aesthetic quality of the flowers, but also may dictate the composition of floral visitors through competition for resources of individual flowers with other insect species. In a related study by Allain et al. (1999) in southern Louisiana, hymenopterans like honey bees constituted nearly 75% of the insect pollinators on magnolia. From the 44 species collected from flowers in our study, honeybees and Japanese beetle were extensively covered (>100) with pollen, while the remaining insect species had few (<10) to moderate (<100) numbers of pollen grains (Figure 4). Pollen grains (0.9µm long, and 0.5µm in diameter) were found on the insect body (i.e., the exoskeleton), attached to the hair-like setae, and packed into the pollen baskets of honeybees. Pollen grains on Japanese beetles were most commonly found on the dorsal surface of the head and thorax.

This study provides an extensive checklist of the 476 insect species associated with Southern Magnolia. Because Southern Magnolia harbors a vast assemblage of insect species in both urban and forest environments, its presence greatly contributes to the biodiversity of the insect fauna and the stability of forests in eastern Tennessee. Additional studies are needed to assess the impact of insects on Southern Magnolia in urban and forest settings.

Literature Cited

Allain, L.K., M.S. Zavada, and D.G. Matthews. 1999. The reproductive biology of Magnolia grandiflora. Rhodora, Vol. 101:143-162.

Baker, W. L. 1972. Eastern Forest Insects. USDA For. Serv. Misc. Pub. No. 1175. Washington, D.C. 317 pp.

Goulet, J. H. 1993. Hymenoptera of the World: an Identification Guide to Families. Centre for Land and Biological Resources Research, Ottawa, ON. 668 pp.

Grimm, W. C. 1967. Familiar Trees of America. Harper and Row Publ. New York.

Halls, L. K. 1977. Southern magnolia/Magnolia grandiflora L. U.S. Southern Forest Experiment Station. USFS Gen. Tech. Rpt. 50-16:196-197.

Herms, D. A. 2003. Weighing in on Scale. J. of Magnolia. 38(73):25-29.

Kosztarab, M. 1996. Scale Insects of Northeastern North America: Identification, Biology, and Distribution. Virginia Mus. of Nat. Hist., Martinsville, VA. 660 pp.

Leibee, G. L., and K. E. Savage. 1994. Insecticidal Control of Magnolia White Scale on Magnolia grandiflora L. Proc. Ann. Mtg. FL. St. Hortic. Soc. 107:226-228.

Mead, F. W. 1971. Annotated Key to Leaffooted Bugs (Leptoglossus sp.) in Florida (Hemiptera:Coreidae). FL Dept. Agric. Entomol. Circulation No. 113, 4 pp.

Mitchell, P. L., and F. L. Mitchell. 1983. Range Extension of Leptoglossus fulvicornis with Observations on Egg Parasitism. Southwest. Entomol. 8:150-153.

Thien, L. B. 1974. Floral Biology of Magnolia. Am. J. Bot. 61:1037-1045.

Yasukawa, S., H. Kato, R. Yamaoka, H. Tanaka, and S. Kawano. 1992. Reproductive and Pollination Biology of Magnolia and its Allied Genera (Magnoliaceae): 1. Floral Volatiles of Several Magnolia and Michelia Species and their Roles in Attracting Insects. Plant Species Biol. 7:121-140.

Werle, C. 2002. Insects associated with southern magnolia (Magnolia grandiflora L.) in East Tennessee. M.S. Thesis., Univ. of Tennessee, Knoxville, TN. 77pp.

Wheeler, A. G,. and G. L. Miller. 1990. Leptoglossus fulvicornis (Heteroptera: Coreidae), a Specialist on Magnolia Fruits: Seasonal History, Habits, and Descriptions of Immature Stages. Ann. Entomol. Soc. Am. 83:753-765.

Wheeler, A. G., and J. F. Stimmel. 1988. Heteroptera Overwintering in Magnolia Leaf Litter in Pennsylvania. Entomol. News. 99:65-71.

Williams, M. L., and M. Kosztarab. 1972. Morphology and Systematics of the Coccidae of Virginia with Notes on their Biology (Homoptera: Coccidae). Va. Polytech. Inst. and State Univ. Res. Div. Bull. 74: 84-90.

Direct Correspondance to: Paris L. Lambdin
Dept. Entomol. & Pl. Pathol.
University of Tennessee
Knoxville, TN 37996
Ph. (865) 974-7135
Fax(865) 974-4744
e-mail: plambdin@utk.edu