Insects Attacking Black Walnut in the Midwestern United States

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ABSTRACT—Black walnut has only a handful of insects that would be considered significant pests. Of the leaf feeders, the walnut caterpillar is the most likely to cause significant defoliation and damage to trees. However, severe infestations are infrequent and tend to be restricted to small geographic areas. Two other commonly encountered defoliators are the yellow necked caterpillar and the fall webworm. The black walnut curculio is the major nut pest on black walnut. The walnut shoot moth attacks buds and shoots of black walnut. Destruction of the terminal bud or shoot on young trees can cause excessive branch forking that can change the shape of a tree. Walnut does have several wood boring insects that will invade the main trunk and larger branches. Most of them infest trees that are in poor health. Many can also invade freshly cut logs. An ambrosia beetle, *Xylosandrus germanus,* can attack apparently healthy trees and attacks are often associated with the pathogen *Fusarium.* Management practices are provided that should minimize insect caused impacts

INTRODUCTION

Black walnut has an array of insects that feed on its leaves and developing nuts, and tunnel into buds, shoots, twigs, and through bark into the wood. However, only a few insects would be considered significant pests. Perhaps the most important are those that tunnel into developing shoots and buds on younger trees. The destruction of the terminal bud or shoot on a young tree can cause excessive branch forking that can change the shape of a tree and reduce its timber value. There are also insects that can infest the main stem of living trees though generally this occurs on weakened or damaged trees. Freshly cut logs can also be invaded. These wood boring insects can introduce a number of fungi and other pathogens, and their tunnels can cause degrade in the value of wood products. Leaf feeding insects are not uncommon and outbreaks do occur. But, most outbreaks tend to be short-lived on walnut and widespread tree mortality is not often reported. Nut production can be reduced by weevil attacks on developing nuts and insects that infest the husk.

SPECIFIC DAMAGING INSECTS

Weber and others (1980) developed a publication on diagnosing the most common damaging agents on black walnut. This publication is no longer in print, but can be accessed via the internet at: http://www.na.fs.fed.us/spfo/pubs/howtos/ht_walnut/cover.htm.

Information on identification of many walnut insects can also be obtained by using Johnson and Lyon (1988) and USDA (1985). Information on wood boring insects attacking walnut is available in Solomon (1995).

Insects Damaging Foliage

Loss of leaf tissue is referred to as defoliation. The impact that insect caused defoliation has on a tree can include growth loss, mortality, and increased susceptibility to other insects and pathogens (Kulman 1971). But, leaf feeding and leaf loss may not always be a problem, in some situations it may even be beneficial by stimulating growth through increased nutrient cycling or by acting as a thinning agent (Schowalter and others 1986). Therefore, leaf feeders do not always need to be controlled. Control activities should be limited to protecting young trees and trees weakened by previous defoliation or drought stress. Though not well documented in black walnut, reduced tree vigor can make trees more susceptible to wood boring insects and some pathogens. In most situations, trees that are

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Citation for proceedings: Michler, C.H.; Pijut, P.M.; Van Sambeek, J.W.; Coggeshall, M.V.; Seifert, J.; Woeste, K.; Overton, R.; Ponder, F., Jr., eds. 2004. Black walnut in a new century, proceedings of the 6th Walnut Council research symposium; 2004 July 25-28; Lafayette, IN. Gen. Tech. Rep. NC-243. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 188 p.

healthy or vigorous will survive defoliation events and probably do not need to be protected.

A number of defoliators of black walnut are listed in USDA (1985) and Johnson and Lyon (1988). The most commonly encountered defoliators on black walnut are the walnut caterpillar, *Datana integerrima*, Grote & Robinson, yellow necked caterpillar, *Datana ministra* (Drury), and the fall webworm, *Hyphantria cunea* (Drury). These are all moth species. They are discussed in more detail below. Two other moth species that can on occasion be locally abundant include the variable oakleaf caterpillar, *Heterocampa manteo* (Doubleday), and the pecan leaf casebearer, *Acrobasis juglandis* (LeBaron).

In addition, there are several very large caterpillars that feed on walnut, the adult moths are some of our largest native insects. They include the walnut sphinx, *Cressonia juglandis* (J.E. Smith), hickory horned devil, *Lophocampa caryae* (Harris), and luna moth, *Actias luna* (L.). These species are rarely damaging and in most cases they do not need to be controlled.

A few beetle adults and sawfly larvae eat black walnut leaves, though none are considered major pests. June beetles, *Phyllophaga* sp., and the Japanese beetle, *Popillia japonica* Newman, can defoliate trees. June beetles often feed at night and large groups tend to congregate on a single tree. Widespread damage is unusual. The butternut woollyworm, *Eriocampa juglandis* (Fitch), is a sawfly that feeds on *Juglans*. Larvae feed in groups and can defoliate individual branches or small trees. The butternut woollyworm can be conspicuous because of white "woolly" tufts that cover the larval body.

Some leaf damage can occur from aphid, lace bug and mite feeding that can cause leaves to become distorted, discolored or to senesce and drop. Aphids and lace bugs are small insects that use their straw-like mouthparts to suck sap. Mites also remove sap and can scrape away leaf tissue. The walnut lace bug, *Corythuca juglandis* (Fitch), is a common species found on black walnut leaves. Both adults and immatures feed on the undersurface of the leaf creating small necrotic spots. The velvet gall mite, *Eriophyes caulis* Keifer, forms a twisted velvety red growth on the stem of leaflets. This is conspicuous, but relatively harmless.

The walnut caterpillar is the most likely to cause significant defoliation and damage to trees (Farris and others 1982). Trees of all sizes can be attacked though damage is often greatest on isolated individual trees. Severe infestations are infrequent and tend to be restricted to small geographic areas. It generally requires 2-3 consecutive years of heavy defoliation before trees begin to die and most outbreaks last no longer than 2 years. Tree mortality has not been widely reported following walnut caterpillar outbreaks. The number of generations varies from one in northern portions of the U.S. to three in southern regions. A number of natural enemies appear to be important in maintaining walnut caterpillar populations at reasonable levels (Farris and others 1982). On small trees hand removal of larvae can be helpful, especially since caterpillars tend to congregate when young. Insecticide treatments can be successful, but are rarely warranted. The yellow necked caterpillar is a close relative of the walnut caterpillar and outbreaks should be treated in a similar manner to walnut caterpillar.

Fall webworm outbreaks occur in late summer. The caterpillars form large webs that can enclose branches and even entire trees. The large webs can bring attention to the presence of this insect. However, late season defoliation (September) does not often impact trees as much as early season defoliation (May and June) and damage. Growth loss or branch and tree mortality from this insect is rarely reported.

Insects Damaging Nuts

There are insects that specifically feed on developing nuts. A weevil, the black walnut curculio, *Conotrachelus retentus* (Say), is the major insect pest on black walnut in the eastern U.S. In addition, the codling moth, *Cydia pomonella* (L.) and two closely related fly species, the walnut husk maggot, *Rhagoletis suavis* (Loew) and walnut husk fly, *R. completa* Cresson, can infest the husk that covers nuts. Codling moth larvae can attack at an early stage in nut development leading to premature nut drop. On mature nuts, the husks can be infested with codling moth larvae or the maggot stage of the husk flies. This can result in husks turning black and shriveling making nut extraction difficult.

The adult black walnut curculio is a relatively small weevil, about 1/5 inch long. Larvae feed in developing nuts on black walnut causing nuts to drop prematurely (Blair and Kearby 1979). This is referred to as the "June drop" of walnuts (Weber and others 1980). Egg laying occurs on developing nuts shortly after flowers are fertilized. Larvae tunnel into developing nuts and within a few weeks infested nuts drop from the tree. On the ground, larvae remain in the nuts for about 2 weeks after which they chew an exit hole in the husk and enter the soil. In the soil they pupate into adults. The adults emerge in mid to later summer and spend the remainder of the year feeding on black walnut

foliage. When leaf drop occurs, adults move into the soil where they spend the winter.

A 2-year study done in Missouri, reported 51 percent of the annual nut production dropped early as a result of black walnut curculio infestations (Blair and Kearby 1979). In a 10-year study on the impact of the black walnut curculio in southwestern Missouri, Linit and Stamps (personal communication) reported that curculio-caused nut loss ranged from virtually none to 26% of the available nuts. For years in which the final harvest nut crop was known, loss of nuts from weevil oviposition was high in years with small nut crops and low in years with large nut crops. This suggests weevil populations may remain relatively stable and destroy a constant number of nuts from year to year.

A sanitation program based on rapid removal and destruction of nuts that have fallen in early summer should reduce the local populations of weevils. However, this must be done before weevils migrate to the soil. Sanitation can also help reduce codling moth and husk fly populations. Early summer insecticide applications can be targeted at these insects. A pheromone attractant is available for adult codling moths that can help in the proper timing of any insecticide application. Baits are also available for attracting the husk flies.

Insects Damaging Buds and Shoots

Bud and shoot damage can appear rather innocuous. However, the destruction of buds or shoots, especially the terminal bud or shoot on young trees, can cause excessive branch forking that can change the shape of a tree and reduce its timber value. The lack of a single dominant straight stem can be a major impediment to growing well-formed trees.

There are several insects that can damage shoots and buds, but only one appears to be a significant pest. The walnut shoot moth, *Acrobasis demotella* Grote, is commonly found attacking buds and shoots of black walnut (Kearby 1979, Martinat and Wallner 1980). On occasion, a related species, the pecan leaf casebearer, *A. juglandis* (Le Baron), may be problematic. It does not feed in shoots but can kill significant numbers of buds. The butternut curculio, *Conotrachelus juglandis* LeConte, a weevil, can infest black walnut shoots though it prefers butternut (Solomon 1995).

Females of the walnut shoot moth are present in mid-summer and lay eggs on the underside of walnut leaflets. Larvae soon emerge and begin feeding on leaf tissue. When foliage begins to change color larvae migrate to twigs and construct small silken shelters called hibernacula, where they spend the winter. In the early spring, larvae emerge and begin to bore into and hollow-out buds. As leaves begin to emerge and new shoots expand, larvae tunnel into the pith of developing shoots. Entrance holes are covered with silk and frass. Tunnels can reach 18 inches in length, shoots die above the tunnel. By early summer larvae finish feeding, leave the shoots, drop to the ground, and burrow into the litter layer and pupate inside an earthen cell.

Following damage to terminal buds or shoots, McKeague and Simmons (1979) recommended corrective pruning. They defined corrective pruning as the removal of new shoots developing along a branch, leaving one to become the new terminal leader. This should be done in early summer when bud damage is apparent and shoot growth has not been completed. A benefit of pruning is that it helps correct for both frost and insect caused injury. Frost is a common damaging agent to buds.

Insects Damaging Twigs and Small Branches

In contrast to new shoot growth discussed in the section above, a few insects can damage older twigs and small branches. Injury to twigs and small branches would rarely impact tree form or overall tree health. The most common injuries are oviposition wounds from cicadas, planthoppers, and treehoppers, all members of the insect order Homoptera. Females slit the bark on twigs and small branches and imbed eggs within the slits. These wounds can kill twigs and branches.

Twig and branch dieback can also occur due to infestations of scale insects although they are not widely reported on black walnut. Marshall (1989) did list the oystershell scale, *Lepidosaphes ulmi* (L.) as a common walnut pest.

Insects Damaging the Trunk and Large Branches

Walnut does have several wood boring insects that will invade the main trunk and larger branches (Solomon 1995). Most are beetles, a few are moth larvae. Only a few species are considered significant pests and most of these do not kill trees but cause problems by providing sites where disease organisms can become established or by causing defects in wood products through tunnels or associated staining. As mentioned, these insects rarely kill trees but most of them are associated with trees that are declining, dying or recently killed, including cut logs. Only *Xylosandrus germanus* (Blandford), an ambrosia beetle, has been

reported attacking apparently healthy trees (Weber and McPherson 1984).

Ambrosia beetles are relatively small beetles that burrow through the bark and into the sapwood and feed both as an adult and larvae on fungi that they cultivate in their tunnels. These fungi often impart a dark blue or black stain along the tunnels. This staining can cause a degrade in sawn lumber. Black walnut has several species of ambrosia beetles that can infest the trunk and larger branches (Table 1). Most of these attack trees that have existing damage, are growing slowly or have recently died or been harvested. As mentioned earlier, *Xylosandrus germanus* can attack apparently healthy trees and attacks by this beetle have been found associated with the fungus *Fusarium* (Weber and McPherson 1985). *Xylosandrus germanus* was introduced into North America and now occurs throughout the Midwest. Young trees up to 8 years old are most often attacked. The adults bore small entrance holes, about 1/32 inch in diameter. Attacked trees often have top dieback and profuse sprouting from the base of the tree.

Pinhole or wormhole type damage, diagnostic of ambrosia beetles, can also be caused by the sapwood timberworm, *Hylecoetus lugubris* Say. This beetle often infests green saw logs as well as weakened and dying trees. In addition to pinholes that penetrate into the sapwood, there are also many small laterally oriented galleries across the surface of the sapwood.

Larger beetles that infest black walnut in the eastern U.S. include the flat-headed apple tree borer, *Chrysobothris femorata* (Oliv.), the pole borer, *Parandra brunnea* (Fabricius), and the ash and privet borer *Tylonotus bimaculatus* Haldeman. In almost all cases, these insects infest wounded, weakened or dying trees. Externally, infestations can be found via entry wounds that bleed sap or have extruding wood fibers or sawdust.

Recommended control measures for wood-boring insects revolve around maintaining tree vigor. Most of these insects are incapable of successfully invading healthy, vigorous trees. Therefore, management practices such as weed control and thinning can be beneficial. Sanitation, or the removal of infested material can also be useful in reducing local populations of wood boring insects. In addition, limiting wounds on the main stem should reduce attacks from some of these insects. Wounds caused by mowing or logging equipment can be attractive to many wood-boring insects. Pruning wounds tend to heal quickly and are probably not overly attractive. Pruning in the fall and winter would further eliminate the risk of attracting these insects.

Freshly cut logs should be removed rapidly from the woods to avoid attracting wood boring insects. In addition, harvesting activities should be done during colder periods of the year, thus reducing the likelihood of insect activity.

Table 1.—Ambrosia beetles reported attacking the trunk and larger branches of walnut by Solomon (1995).

Name	Importance
Black stem borer, *Xylosandrus germanus*	Considered a significant walnut pest, attack sites are often associated with *Fusarium* cankers. Can attack vigorous trees, especially young walnut trees in plantations. Also attacks dying and diseased trees. Sap may ooze from pinhole sized entrance holes. Fine dust-like frass is often present. Infested trees often suffer top dieback.
Lesser shothole borer, *Xyleborinus saxeseni*	Not considered a major walnut pest. Infests dying or dead material, can attack fresh-cut logs causing a stained pinhole defect. White frass on bark.
Pear blight beetle, *Xyleborus dispar*	Not considered a major walnut pest. More common on fruit trees. Infests injured or dying trees.
Cosmopolitan ambrosia beetle, *Xyleborus ferrugineus*	Not considered a major walnut pest, has a host range of more than 180 species worldwide. Most common attacking stumps and logs on the ground. White frass on bark.
Oak timber beetle, *Xyleborus xylographus*	Not considered a major walnut pest, prefers oaks. Beetles favor lower stumps and lower portions of dead and dying trees. Often attacks around wound sites. White frass on bark.

MANAGEMENT RECOMMENDATIONS

Management of black walnut is largely driven by the desire to develop well-formed trees that have a straight stem. Management activities may be needed to protect young trees from insects that kill the terminal buds or shoots, specifically the walnut shoot moth. Unfortunately, limited direct control options are available for this insect.

1. Corrective pruning can develop a single terminal bud after insect attack or frost injury.

2. Younger trees will often self-correct or straighten if neighboring trees provide competition for light. Therefore, maintain well-stocked stands.

Wood-boring insects tend to infest trees weakened by poor growing conditions or injuries to the main stem. In addition, repeated defoliation by insects or leaf diseases can weaken trees. Therefore, management tactics should target maintaining healthy, vigorous trees. Further, trees should not be damaged during mowing or logging activities.

1. Proper weed control can allow for rapid early growth developing healthy trees.

2. Thinning older stands to develop trees with large vigorous crowns can maintain tree health.

Insecticide applications targeted at defoliating insects are rarely warranted. Most healthy trees should withstand a single defoliation event, especially if it occurs in late summer. But, repeated defoliation events may need to be more actively managed. In addition, young trees and trees stressed by drought events may also require protection.

1. Monitor local populations of insects such as the walnut caterpillar. Seek the advice of a professional forest entomologist if outbreak populations persist for more than 1 year.

Newly harvested logs should be removed from the woods as quickly as possible, especially during the warmer months of the year.

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