TWO LINED CHESTNUT BORER: *Agrilus bilineatus* (Weber)
Order - Coleoptera; Family - Buprestidae

DISTRIBUTION - *A. bilineatus* is indigenous to North America. It is known to exist in southeastern Canada, and throughout the eastern and central United States, and westward to the Rocky Mountains. The range of *A. bilineatus* is based on the probable distribution of its oak hosts.

DESCRIPTION - As with other members in the *Buprestidae* family, the larva has a characteristically flattened head. The body is cream-colored, long, slender, and flattened, having an almost beadlike and delicate form. The posterior end of the larva is uniquely marked by two brown anal spines. Literature sources indicate that the larva may grow up to 25mm in length.

Adult beetles are bullet shaped having bluish-black coloration. The ventral side, and sometimes the dorsal side, may appear iridescent or metallic in color. Usually adult beetles have a light yellowish or whitish pubescent stripe on each elytron. The size of the adult beetles may vary greatly, ranging from 5mm to 13mm.

The egg is approximately 1mm long, appearing oval and somewhat flattened.

HOSTS - The primary host of *A. bilineatus* is oak (*Ouercus spp*.). This would include white oak (*Q. alba*), scarlet oak (*Q. coccinea*) , pin oak (*Q. palustris*), northern pin oak (*Q. elliosoidalis*), bur oak (*Q. macrocarpa*), chestnut oak (*Q. prinus*), northern red oak (*Q. rubra*) , post oak (*Q. stellata*), black oak (*Q. velutina*), and live oak (*Q. virginiana*). Before chestnut blight virtually eliminated the American chestnut (*Castanea dentata*), chestnut was also considered a principal host.

In Midwestern landscape nurseries, red oaks and English oak are most commonly attacked. Other than English oak, members of the white oak species tend not to be attacked as much as members of the red oak species. Swamp white oaks are rarely infested.

DAMAGE - Damage is caused by the larvae which burrow beneath the bark and outer wood of the main trunk and branches. Injury caused to the cambium, phloem, and xylem interrupts the translocation process of the nutrients and water within the vascular tissues which result in sudden wilting and browning of the foliage. Oaks and other ring porous hardwood species conduct water almost entirely within the outer one or two growth rings of the sapwood making them very sensitive to *A. bilineatus* larval attack.

In woodlands and urban wood lots, the damage usually begins at the top of a tree, affecting the upper branches first. As the infested tree weakens, the infestation progresses lower, subsequently affecting the lower branches. Trees can be killed in the first year of attack; however, death usually occurs after two to three successive years of borer infestation. Trees stressed by drought, insect defoliation, or other factors are most susceptible to attack; although literature suggests that healthy trees may be attacked also.

In landscape nurseries, evidence of damage tends to occur primarily on the trunk of the tree and not the branches. Any size host tree, 0.5 inch in caliper size and up, may be affected. But in nurseries, it seems that trees one to three inches in caliper size are affected the worst. Nursery fields having mature woodland and or wood lot oaks in close proximity are extremely susceptible to borer infestations. Non-infested new liners (1-1.5 inches in caliper), planted during the early spring, can have up to 30-50% of the trees infested by mid to late summer. Typically the tops of these infested trees will appear perfectly green and normal after the first season of attack. It is during the second and third years of attack that the tree top dies out, or the entire tree dies.

LIFE CYCLE - (Northern Illinois and Eastern Iowa) In general, *A. bilineatus* has one generation per year. However larvae which feed on healthy host trees, or are located in the northern part of their distribution range, may take two years to complete their life cycle.

Larvae overwinter in pupal chambers constructed just beneath the outer surface of the bark. Most of the larvae spend the winter in the final (fourth) instar in a bent position. However, larvae that were hatched from eggs deposited during mid to late summer will be smaller in size. During the fall, a variety of larval sizes can be excavated from

invested tree trunks (in landscape nurseries). This explains why treatments applied only during May and June are effective, but do not yield satisfactory results.

In the spring, overwintered fourth instar larvae enter the pupal stage. Adult eclosion occurs in the pupal cell. Adults then chew their way to the bark's surface. In landscape nursery trees, wet spots begin to appear on the bark's surface, preceding adult emergence. At this time, *Cercis canadensis* (redbud) is almost in full bloom. Within a short time adults chew D-shaped exit holes and emerge. By this time, *Spiraea vanhouttei* (bridal wreath) is blooming, marking the beginning of the adult flight period (May - in eastern Iowa and northern Illinois). The vast majority of adults emerge during the months of May and June, however a significant amount emerge through the months of July and August also. Adults may also be found during September, but their numbers are much lower.

Adult beetles are gregarious and attracted to sunlight. They feed indiscriminately on the leaves of many hardwood tree species. Females lay eggs in clusters of up to 10 eggs per cluster. Eggs are usually laid deep within the bark crevices, preferably at the bottom, on the sunny side of the tree. The eggs hatch within 10-14 days. Newly hatched larvae bore directly into the bark, begin feeding between the bark and wood, and establish themselves in the phloem region. On mature size host trees (woodland and wood lot trees) the larvae tunnel in a winding zigzag pattern. The tunnels, packed with frass, may extend to 30 cm or more in length. On nursery landscape trees, larvae tunnel in a spiral pattern, and tend to spiral upwards on the trunk. Larvae must feed on living host tissue in order to complete their development. Larval feeding ceases during the autumn and fourth instar larvae burrow outward towards the bark where they create chambers to overwinter.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
[----------Fourth Instar Larvae----------]											
				[--Pupae --]							
					[--Peak Adults--]>>>>----------]						
					[---------- Eggs ----------]						
						[----------Larvae ----------]>>> Fourth Instar Larvae-]					
Observed at: Northern Illinois						General Rule: +/- 1 week for each 60 miles change in Latitude					

INSPECTION TIPS - In mature oak stands, symptoms typically develop at the top of the tree first, showing wilted brown foliage. A tree may die after the first year of an infestation if it is under substantial stress to begin with. However, if the tree has adequate vigor, the first year of an infestation will be limited to the upper crown. Larval presence will be pretty much confined to the upper crown at this time, while the lower crown appears healthy, having normal foliage color, and no signs of larval infestation. During the second and third years of an infestation, the symptoms progress downward, affecting the lower branches, which in turn wilt and brown. At this time, D-shaped adult exit holes can be found in the upper crown, but are absent in the lower crown; however, larvae will only be present in the lower crown, but not be present in the upper crown. This is because the upper crown is dead and *A. bilineatus* larvae require living host tissue in order to complete their development. Many times, during the third year of an infestation, the tree is dead, having no leaves or larvae present in either the upper or lower crown.

In landscape nurseries, *A. bilineatus* can be very difficult to detect, particularly in the early stages of a developing infestation. The main symptoms to look for at this time are swellings and wet spots on the trunk surfaces. These symptoms usually occur from 2-8 feet high on the trunk. These symptoms usually do not appear until about July (when *Hydrangea arborescens* 'Grandiflora' blossoms are turning from white to green). As the summer progresses and the larvae continue to feed and elongate their tunnels, the cambium of the host tree continues to grow around the tunneling of the damaged areas, forming external transverse swellings on the trunk surfaces. These swellings spiral up the trunk outlining the tunneling patterns of the larvae. The swellings can sometimes be very small, or quite extensive depending on the length of time (number of months) the tree has been infested. Using a knife to dig into the transverse swellings, it is easy to follow the packed frass tunnel up to the larva. Sometimes a number of larvae will be spiraling up an infested tree and the tunnels will cross. During the first year of an infestation, the upper canopy of an infested nursery tree will appear normal, with normal foliage color and no D-shaped adult exit holes. It is during the second year of an infestation that the top of the tree may die out and that the characteristic D-shaped adult exit holes may be present.

CONTROL TIPS - Under woodland and wood lot conditions, insecticidal control is considered impractical and not recommended in most situations. Basic sanitation, the removal of infested and dying or weakened trees, is a key to

effective management. Removing an infested or weakened tree before the beginning of the adult emergence period (May - *Spiraea vanhouttei* is in bloom) would also aid to reduce an established population. During July and August, larvae can be killed by debarking felled infested trees.

In landscape nurseries insecticidal control combined with sanitation can be very effective. In the fall, or during the spring, removing and destroying all infested trees is an important part of the control program. Protective treatments should be applied during the adult flight period, which begins when *Spiraea vanhouttei* is blooming. It is important to maintain protective insecticidal treatments through the month of August. May and June are the most important treatment timings, since that is the time when most of the adults are present; however, enough adults are present during the months of July and August to warrant protective treatments through those periods also. If the nursery is in close proximity to a woodland of substantial size which harbor *A. bilineatus*, treating during September may also be of benefit.

A few different insecticides are recommended, but experience shows that persistent insecticides of an emulsion formulation will provide the best control results. Protective treatments should especially target all oak liners.

RELATED SPECIES-

A. bilineatus carpini (Knull) - a wood borer subspecies of Two Lined Chestnut Borer reported as a pest on beech and hornbeams in Pennsylvania and several northern states.
A. anxius (Gory) - Bronze Birch Borer, a wood borer common to many birch species.
A. difficilis - Honey Locust Agrilus Borer, a wood borer common to honey locust.

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PHOTOGRAPHS -

Adult ---
William McAdams, Iowa.

Larva & Galleries --- (Top) William McAdams, Iowa.

Bark swellings & Larva --- (Bottom Left) William McAdams, Iowa.

Galleries --- (Bottom Right) Todd Voss, Iowa.