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Review of Host Trees for the Wood-Boring Pests *Anoplophora glabripennis* and *Anoplophora chinensis*: An Urban Forest Perspective

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Abstract. Two devastating insect pests have been introduced to North America and Europe – the Asian longhorned beetle (ALB) (*Anoplophora glabripennis*) and the citrus longhorned beetle (CLB) (*Anoplophora chinensis*). These two wood-boring beetles are argued to be one of the most serious threats to the tree landscape since they have a large number of host species and genera. With the aim of creating an up-to-date compilation of these hosts, a systematic review was made of the literature for information on tree species attacked and used by ALB and CLB as hosts for complete life cycle or for feeding. This review revealed that a large number of tree species and genera are liable to be attacked by ALB and CLB. However, based on the findings, the whole picture is still unclear. One reason for this is the lack of transparency in published studies regarding lists of susceptible tree species for ALB and CLB. Another factor that needs to be reported is whether a tree species supports the complete life cycle of the beetles or just feeding by adult beetles. Without this information, species possessing moderate host qualities are at risk of being incorrectly labelled as very good hosts and hence excluded as urban trees.

Key Words. *Anoplophora chinesis*; *Anoplophora glabripennis*; Asian Longhorned Beetle; Citrus Longhorned Beetle; Host; Pests; Review; Tree Selection; Urban Trees; Wood-boring Pests.

Today, the urban forest and its constituent trees are much more than an aesthetic green element in cities. Aspects such as biological diversity, stormwater management, pollution relief, beneficial and recreational impacts on human well-being, and urban heat island mitigation are some of the services urban tree vegetation provides for city dwellers (Forman and Godron 1986; Grahn and Stigsdotter 2003; Maco and McPherson 2003; Tyrväinen et al. 2005; Geldof and Stahre 2006; Nowak et al. 2006; King and Davis 2007). In the compact city, the qualities provided in large parks and green areas will be compressed into smaller scale units or alternative green structures, increasing the demands on capacity load and performance level of future urban green space and future urban trees (Sjöman et al. 2012a). Since trees are long-lived organisms and their capacity to deliver ecosystem services is not completely developed until they are fully grown individuals, it is of the utmost importance that the trees selected today last into the future. However, today's urban trees and forests are facing great difficulties with pests and diseases and with a changing climate, which can compromise their future development and functions. It is therefore important to determine which species and genera of trees can meet these future challenges (Sjöman et al. 2012b).

In the last decades, two important and devastating insect pests have been introduced to North America and Europe – the Asian longhorned beetle (ALB) (*Anoplophora glabripennis*) and the citrus longhorned beetle (CLB) (*Anoplophora chinensis*). These two wood-boring beetles are argued to be one of the most serious threats to the tree landscape since they have a large number of host species and genera (e.g., MacLeod et al. 2002; Raupp et al. 2006; Hu et al. 2009; Haack et al. 2010). Well-known hosts for ALB in China include species of *Acer*, *Alnus*, *Betula*, *Eleagnus*, *Fraxinus*, *Malus*, *Platanus*, *Populus*, *Pyrus*, *Salix*, *Sophora*, and *Ulmus* (Haack et al. 2010). In the United States, ALB has completed development on species in the genera *Acer*, *Betula*, *Fraxinus*, *Pyrus*, *Salix*, and *Ulmus*, but also in species of *Robinia* (Haack et al. 2010), indicating that this beetle is expanding its host range as it invades new territories and encounters new potential host species with devastating biological and economic consequences. For example, Nowak et al. (2001) used tree inventories to estimate potential monetary losses resulting from ALB in nine cities in the United States and reported an estimated loss of approximately 1.2 billion trees, at a compensatory value of USD $669 billion. To combat pests such as the longhorned beetle, providing a large diversity of tree species and genera is argued to be one of the most important solutions. Therefore, it is essential, in the long-term planning of the urban treescape, to use tree species and genera that face a minimal risk of being attacked by these two wood-boring pests.

The aim of this study was to create an up-to-date compilation of the tree species that ALB and CLB attack and use as hosts for a complete life cycle or for feeding. A systematic literature survey (Wright et al. 2007) was conducted to identify relevant species and the findings were assessed in terms of origin, method used, and any weaknesses and limitations in the information provided.

MATERIALS AND METHODS

Biology and Distribution of the Longhorned Beetles

To understand the information presented in the review and the following discussion, it is important to understand the biology and distribution of the two longhorned beetle species. The native range of ALB includes China and Korea, while that of CLB also includes Japan with occasional records from Indonesia, Malaysia, Philippines, Taiwan, and Vietnam (Lingafelter and Hoebeke 2002). The life cycles of ALB and CLB are similar and well described (Haack et al. 2010). Adult beetles undergo a one- to two-week period of maturation, feeding on foliage and tender bark on the twigs of host trees before beginning to reproduce (Keena 2002; Smith et al. 2002). The females of ALB chew slits or funnel-shaped holes through the bark of host trees and lay their eggs under the bark, while CLB females only chew slits before laying the eggs. Only a single egg is laid in each oviposition site (Lingafelter and Hoebeke 2002; Hérard et al. 2006). ALBs typically initiates oviposition along the upper trunk and main branches (Haack, 2006), whereas CLBs usually lay eggs along the lower trunk, root collar region, and on exposed roots (Hérard et al. 2006). Larvae feed in the cambium and then bore into the wood, where they continue to feed, eventually forming a pupal chamber. Larval boring produces structural weakness and disrupts the flow of water and nutrients within host trees, leading to death of branches and ultimately whole trees. Adult feeding on twigs and foliage is considered of minor importance, except occasionally on fruit-bearing trees. Most damage results from larval tunneling in the cambial regions and wood. Both species attack healthy and stressed trees, varying in size from small bonsai and potted trees (especially CLB) to mature trees (Haack et al. 2010).

Outside their native range, both ALBs and CLBs have caused tree mortality and are ranked as high-risk quarantine pests (MacLeod et al. 2002). Both ALB and CLB have been intercepted in wood packaging material associated with imports, such as steel, ironware, pottery, and other materials, as well as in living plants, such as bonsai or nursery stocks originating primarily from China. The main introduction of ALB into new regions has been through wood packaging material, while CLB has mainly been introduced through living plants (Haack et al. 2010). The first discovery of an established population of ALB outside of its native range was in North America in 1996 (Haack et al. 1997), and that of CLB in Europe in 2000 (Hérard et al. 2006).

Host Tree Review

The literature reviewed to find information concerning host trees for ALB and CLB included scientific articles and official documents concerning invasive pests. The search included the Google Scholar, Scopus, and CAB abstract databases (ISI Web of Knowledge), and the reference lists within the publications found in these databases. In the initial search in the databases, the search terms used were: Asian longhorn beetle, citrus longhorn beetle, ALB, CLB, *Anoplophora glabripennis*, and *Anoplophora chinensis*. Since *Anoplophora malasiaca* is argued to be a synonym of *A. chinensis* (Lingafelter and Hoebeke 2002), researchers also included this name in the search. In the compilation of literature, the search was limited to publications written in English, Swedish, Norwegian, Danish, Dutch, French, German, and Italian. For publications written in Chinese and Japanese with an abstract in English, only the abstract was included.

In total, 35 publications were found with information concerning host species for these two longhorned beetles. The suitability of tree species as hosts was ranked as: very good host, good host, host, and rare/resistant based on information in the literature reviewed—for definitions used to classify hosts, see Table 1 (Yin and Lu 2005). In the publications studied (Appendix 1; Appendix 2; Table 2), there was lack of consistent information on whether there is a complete life cycle of the beetles in the trees or if the adult beetles were simply feeding. When the information was imprecise regarding how a beetle attacks and feeds on a tree species, the species was ranked provisionally as a host. Information regarding the possibility for larva development by the beetles was included for all species (Appendix 1; Appendix 2).

The information found in the review was then further analyzed in terms of aspects such as the origin of the findings [i.e., whether the information had been obtained through controlled greenhouse studies or studies in natural environments or plantations (Appendix 3)]. The geographical focus of the study was also included, as were any citations of the publication in the Scopus database. Host-related information within the studies was also analyzed to trace its origin (Appendix 3).

RESULTS AND DISCUSSION

Of the 35 papers reviewed, 29 contained information on host trees for ALB, while only 13 had corresponding information for CLB. The total number of papers exceeded 35, since some studies covered both ALB and CLB and were therefore counted twice (Appendix 1; Appendix 2; Appendix 3; Table 2).

In the compilation of host trees for ALB, 36 species were mentioned as a host to some degree, while 31 genera were described as being at risk of attack—these genera obviously included many more than 36 species. The species described most frequently as a host to some degree was *Acer platanoides*, followed by *A. saccharum* and *A. negundo*. The genera described most comprehensively as a good host for ALB were *Populus* spp., *Salix* spp., and *Acer* spp., followed by *Betula* spp., *Ulmus* spp., and *Platanus* spp. (Appendix 1).

In the compilation of host trees for ALB, there were also 31 species and 16 genera that were described as resistant or rarely infested (Appendix 1). However, as can be seen from Appendix 1, there were some clear contradictions concerning which species and genera were susceptible. For example, some publications described a particular genus or species as a host to some degree, while others described them as resistant or rarely infested. Further, five publications described *Tilia* spp. as a host for ALB (Nowak et al. 2001; Ric et al. 2006; Hu et al. 2009; Jordbruksverket 2010; APHIS 2012), while two other publications stated that the genus of lime trees is rarely affected or even resistant (Haack et al. 1997; Raupp et al. 2006). This contradiction regarding which species can be characterized as hosts is even more pronounced in studies focusing on poplar trees (*Populus* spp.) and their susceptibility to ALB. Since there has been enormous use of poplar trees to counteract desertification in northwestern China, several studies evaluate these poplar plantations and outbreaks of ALB (Lingafelter and Hoebeke 2002; Yin and Lu 2005; Yang 2005; Hu et al. 2009 and references therein). In these studies, it is obvious that not all poplar species are classified as a very good host for ALB, even if the genus is described as one of the

Table 1. Division of host susceptibility into: very good host, good host, host, and rare/resistant.

Host grade	ALB and CLB feeding and life cycle features	Impact on tree growth
Very good host	Attracts longhorned beetles. Extensive feeding by adult beetles. Complete life cycle with population increase	Dieback of whole tree crown or entire tree
Good host	Moderate feeding. Can complete life cycle	Dieback on some branches. Dieback of whole tree crown or entire tree if stressed
Host	Limited feeding by adult beetles. Small number of eggs laid. Can escape attack if nearby trees are more susceptible	Normal growth. Slight damage with recovery wounds
Resistant or rarely affected	No feeding activity by adult beetles; no eggs laid	Normal growth

Table 2. Categorization of poplar species as hosts for ALB according to Gao et al. (1997), Ludwig et al. (2002), Wang (2004), Yin and Lu (2005), Yang (2005), and Hu et al. (2009).

Category	Species/hybrids	Section
Very good hosts	*Populus nigra:* 'Pyramidalis', 'Italica', 'Thevestina'	*Aigeiros*
	Populus deltoides 'Brangarsi'	*Aigeiros*
	Populus × euramericana: 'Luisa Avanzo', 'Bellini', 'Guardi'	*Aigeiros*
	Populus × xiaozhuannica, P. × xiaozhuannica: 'Opera', 'Popularis'	*Aigeiros × Tacamahaca*
Good hosts	*Populus nigra*	*Aigeiros*
	Populus deltoides	*Aigeiros*
	Populus lasiocarpa	*Leucoides*
	Populus pseudoglauca	*Leucoides*
	Populus cathayana	*Tacamahaca*
	Populus gansuensis	*Tacamahaca*
	Populus pseudosimonii	*Tacamahaca*
	Populus simonii	*Tacamahaca*
	Populus ussuriensis	*Tacamahaca*
	Populus simonii × P. nigra 'Pyramidalis': 'Baichensis', 'Taiqing', 'Italica'	*Aigeiros × Tacamahaca*
	Populus nigra × P. simonii	*Aigeiros × Tacamahaca*
	Populus × beijingensis	*Aigeiros × Tacamahaca*
	Populus × berolinensis	*Aigeiros × Tacamahaca*
	Populus × dakuanensis	*Tacamahaca*
	Populus × russki	*Aigeiros*
	Populus stalinetz	*Aigeiros*
	Populus × xiaohei, P. × xiaohei 'Heilin-1'	*Aigeiros × Tacamahaca*
Occasional hosts	*Populus deltoides*: 'Nankang', 'Qingji #1, 2', 'Shanhaiguan', 'pyramidalis'	*Aigeiros*
	Populus balsamifera	*Tacamahaca*
	Populus alba 'Pyramidalis'	*Populus*
	Populus alba × Populus bolleana	*Populus*
	Populus alba × Populus tomentosa	*Populus*
	Populus deltoides × P. simonii	*Aigeiros × Tacamahaca*
	Populus × euramericana (= P. × canadensis)	*Aigeiros*
	Populus × euramericana 'Veruirubens', 'Vegeherata 272', 'G-158', 'I-214', 'Triplo', Gattoni', 'Cima'	*Aigeiros*
Rare hosts or resistant hosts	*Populus euphratica, P. euphratica: 'Pyramidalis'*, 'PE-214'	*Turanga*
	Populus pruinosa	*Turanga*
	Populus alba	*Populus*
	Populus davidiana	*Populus*
	Populus hopeiensis	*Populus*
	Populus tomentosa, P. tomentosa 'Hopeinica', 'Honanica'	*Populus*
	Populus tremula	*Populus*
	Populus tremuloides	*Populus*

most susceptible (Appendix 1 and Table 2). In the division between poplar species with differing susceptibility to ALB, it is obvious that there are differences between sections in the genus, with species within the sections *Populus* and *Turanga* even being classified as resistant or rarely infested (Table 2).

The compilation on CLB included fewer publications describing host trees. However, the number of host species described was much greater than for ALB. In total, 108 species were described as a potential host for CLB, while the number of genera was 73 (Appendix 2). In the literature reviewed, no species or genus was described as resistant or rarely affected by CLB. The species described most frequently as a host to some degree were *Acer palmatum* and *A. platanoides*, followed by *A. pseudoplatanus* and *Aesculus hippocastanum*. The genera described most comprehensively as a good host for CLB were *Acer* spp., *Malus* spp., and *Citrus* spp., followed by *Populus* spp. and *Platanus* spp. (Appendix 2).

In an attempt to make an up-to-date compilation of host trees for ALB and CLB, researchers identified great confusion in the literature, which weakened the information and may lead to incorrect conclusions and recommendations. In host-related publications, there was much cross-referencing between the papers, making it difficult to identify the origin of the information and how it was obtained. Since a large proportion of the publications on ALB are in Chinese, it is even more difficult to evaluate the background to the conclusions presented in abstracts. Later publications, basing their information on Chinese and Japanese studies (e.g., Haack et al. 1997; Nowak et al. 2001; Lingafelter and Hoebeke 2002; Yin and Lu 2005; Yang 2005; Hu et al. 2009), mainly presented the findings quantitatively with a concluding list of susceptible species, and without a qualitative description of how these conclusions were reached. For example, Yang (2005) and Yin and Lu (2005) reviewed Chinese research concerning ALB but presented the findings very briefly and without an introduction to the methodology and approach used in the studies. This might be the reason why there are some contradictions regarding the suitability of different species and genera in Appendix 1. Furthermore, it is often unclear whether the findings listed in the appendices and Table 2 refer to damage by adult beetles, as specified by Ludwig et al. (2002), Morewood et al. (2003), and Morewood et al. (2004a), or refer to use of the trees for oviposition and larval development. Such information is rarely presented in the publications reviewed, which weakened the information and leads to further confusion.

In the compilation of host trees for the two longhorned beetles, there was a rather large amount of information concerning tree genera, which of course include many more species than those listed in the appendices and Table 2. Including whole genera as a host, for example, CLB may cause the use of a whole genus to be banned, even if there are just a few species that are susceptible and the rest are resistant or rarely affected. When interpreting information from one study in another, it is tempting to simplify the information. An example is Van der Gaag et al. (2010), presenting a list of hosts for CLB based on original data in Lingafelter and Hoebeke (2002), most of which was in turn based on information in Chinese and Japanese studies (Appendix 3). Lingafelter and Hoebeke (2002) listed a large number of species as hosts for CLB, but in the compilation by Van der Gaag (2010), much of this species information was changed to whole genera, without further information. This simplification of host-related information can result in great confusion and misunderstanding, especially if it is used by national authorities to formulate recommendations on trees to avoid in example urban environments. The present review uncovered clear evidence that there are species within highly susceptible genera that are resistant or rarely affected. For example, Williams et al. (2004) evaluated 12 maple species in native communities of South Korea for ALB damage and found that only five species (three native and two invasive exotic species) had visible damage or adult ALB, leaving seven species with no observed damage. Furthermore, even within the poplar genus, which is considered the most susceptible to ALB, there is evidence that sections within this genus are resistant or rarely affected (Weilun and Wen 2005). In a compilation by Hu et al. (2009) based on data from Yin and Lu (2005) and Gao et al. (1997), poplar species belonging to the section *Turanga* (e.g., *Populus pruinosa* Schrenk) and *Populus* (e.g., *Populus alba* L., *P. tomentosa* Carr., and *P. tremula* L.) were listed as less susceptible or slightly resistant to ALB (Bao et al. 1999; Table 2). These examples of resistant species within highly susceptible genera might indicate that there has been generalization regarding the species and genera classified as hosts. If several species have been shown to be susceptible to ALB, it is easy to conclude that the whole genus is susceptible.

The fact that the first discovery of longhorned beetles outside their native range took place in 1996 in New York (ALB) (Lingafelter and Hoebeke 2002) is reflected in the geographical focus of the publications reviewed. ALB host-related publications older than 1996 were mainly produced in China, Japan, and Taiwan (Appendix 3), while publications later than 1996 had a greater focus on North America. CLB host-related publications later than the year 2000 mainly had a European focus, following the first recognized outbreak in Europe (Appendix 3).

Information about whether a tree species is a host, good host, or very good host was fairly commonly provided in the literature reviewed. However, it was more difficult to find clear definitions of the terms used to describe the kind of damage done by the beetles to the tree. Terms used commonly in the literature were: infested, attacked, host, and feeding. For the beetles to become established in an area they not only need to find food, but also to be able to propagate, which means finding suitable tree species for oviposition and larval development into fully developed beetles. Ric et al. (2006) noted that not all tree species are suitable for the whole reproduction cycle. For example, some species are suitable for oviposition but not larval development. Other species are used for feeding by the adult beetles but not for oviposition. The terms infested, attacked, host, and feeding do not clearly describe whether the tree is used for feeding by adults or whether full larval development is possible. Haack et al. (1997) used "primary host tree" and "occasional host tree," "attack primarily" and "complete development" in the "Range and Life Cycle" section for ALB. Hérard et al. (2006) mentioned infested trees and host plants without specifying the meaning, and stated that certain species were preferred host plants, but not whether this meant feeding, oviposition, or full development. FAO (2007) explained that the larvae injure the tree by tunnels under the bark and bore into wood, but when listing trees species it stated "the main genera of trees that it feeds on are. . ." This is confusing, as adult beetles feed on some trees but oviposition and larval development do not always occur on the same species as adult feeding. The Danish Natural Agency (Naturerhvervstyrelsen 2012) concluded that one should distinguish between host plants where the beetles can undergo full development, and host plants where the adults feed on the trees. There are several examples of rating systems that include the possibility of a reproductive cycle for the species. For example, Yin and Lu (2005) used a scale from 1 to 5 to rate tree species, where grades 3 to 5 included the ALB being able to complete a life cycle. Ric et al. (2006) used a three-point rating system, where 1 was suitable for the entire life cycle, 2 was where the beetles had laid eggs but there was no evidence that a whole cycle was possible, and 3 was for species with unknown suitability for beetle larval development.

Among the studies concerning ALB, Ludwig et al. (2002), Smith et al. (2002), MacLeod et al. (2002), Morewood et al. (2003; 2004a; 2004b; 2005), Auclair et al. (2005), and Hajek and Kalb (2007) had obtained their host-related information from greenhouse tests, while the remaining publications appeared to refer to cases and observations in native communities or in public plantations. Only one of the 13 studies of CLB reviewed had obtained host-related information from greenhouse tests (Adachi 1994; Appendix 3). To develop more accurate species-related information concerning susceptibility to ALB and CLB, some authors point out that controlled laboratory tests are needed (MacLeod et al. 2002; Morewood et al. 2004a). However, when beetles are introduced to one or few species in a controlled environment, they may use less favorable species in the absence of more susceptible species. Therefore, host-related conclusions from controlled laboratory or greenhouse tests must be thoroughly analyzed. However, if a species in these tests shows resistance to the beetles, this could be important information. In the review by Yin and Lu (2005), a number of tree species native to China were classified as resistant or rarely affected by ALB (Appendix 1). In fact, the majority of the species/genera classified as resistant or rarely affected by ALB in Appendix 1 are native to China and Japan, where they have been living for generations, side-by-side with the beetle and might have developed natural strategies to avoid attacks. For example, there may be chemical substances in the wood making it unattractive for feeding or unsuitable to support complete development of the ALB (Morewood et al. 2004a). Once the biochemical basis of resistance against ALB and CLB is elucidated, researchers may have a greater understanding of species that are superior to use, while any biocidal compounds produced could perhaps be manipulated to help protect more vulnerable trees from these pests. In the study by Morewood et al. (2004a), an evaluation of four tree species for ALB in controlled greenhouse conditions showed that the Chinese callery pear (*Pyrus calleryana*) was most likely to cause adult mortality of the beetle. No larvae survived, although eggs in callery pear hatched and the neonates began to feed and construct galleries in the wood. In work on ALB and CLB, it is interesting to know not only which species are resistant or rarely affected by these beetles, but also why they are resistant or rarely affected.

Data on citations of host-related information within the publications reviewed here clearly revealed a large number of cross-references, especially among recent studies. For example, the paper by Lingafelter and Hoebeke (2002) was included in six other publications as a host-related reference, but they in turn based their host-related information mainly on older Chinese and Japanese studies (Appendix 3). This pattern of much older host-related information originating from Chinese studies, especially for ALB, makes it difficult to analyze the methodology and approach used in the studies or to evaluate from where and how the conclusions were developed. The most frequently cited publication within this review (that by Nowak et al. 2001) used three Chinese studies (in Chinese) and two unpublished sources from North America as the basis for a host-related evaluation. More recent studies from North America and Europe make a much more transparent presentation of the studies, which makes it possible to evaluate the findings. However, the international reviews included within the present study (Lingafelter and Hoebeke 2002; Hu et al. 2009; Haack et al. 2010) based much of their host-related information on Chinese studies, written in Chinese (Appendix 3).

Furthermore, it is important to know the environments in which the beetles have been studied. In forest types, where very good hosts are absent, the beetles use more "non-traditional" species and genera to a much larger amount than when more suitable host trees are available. This scenario can lead to one author reporting that a species or genus is a very good host and another concluding that the same species or genus is rarely or never infested. Among the publications reviewed, eight based their host-related information for ALB and CLB on natural environments or plantations (Appendix 3) but provided no information on the species composition, structure, or succession phase of the habitat or plantations studied. This makes it difficult to analyze the results presented. Studies in habitats reported larger numbers of highly susceptible species than those in homogeneous sites or plantations. This scenario of including more suitable species is exploited in practice in China, where 'trap trees' that are more utilized by ALB are included to protect other species. No studies concerning 'trap trees' for CLB were found. Furthermore, Williams et al. (2004) concluded that the varying dynamics of ALB populations across its geographical range may indicate that it is an 'edge specialist' that evolved in riparian habitats. This aspect of understanding the preferred habitat or ecosystem of the beetle was seldom evaluated in the literature reviewed. Instead, the information reported originated from different kinds of plantations with quantitative observations mainly in urban areas of China or North America (Hu et al. 2009; Haack et al. 2010), without further evaluation of ecosystem preferences.

CONCLUSIONS

The wood-boring Asian longhorned beetle and citrus longhorned beetle may pose serious threats to the tree landscape worldwide since they have many host species and genera. It is therefore important to identify susceptible tree species and genera in order to produce future tree loss scenarios and plan future urban forests (e.g., by selecting less susceptible urban trees). This literature review found many tree species and genera that are liable to be attacked by ALB and CLB, but further information is needed. There is a lack of transparency in published studies listing susceptible tree species for ALB and CLB. It is important to know where and how these studies obtained their information—especially the older studies. Later studies use a much more transparent approach, but more information from the natural environment of the beetles in China and Japan is highly important in understanding why some species and genera are resistant or rarely affected. Another area where more information is needed regarding host trees for ALB and CLB is whether the tree species support the complete life cycle of the beetles or just feeding by adult beetles. An accepted and internationally used conceptual ranking system is needed, describing what exactly makes a tree species a very good host or just a host. Without this system, there is a risk of incorrectly labeling species with moderate host qualities as a very good host and hence banned from use as an urban tree. Another important aspect is to thoroughly evaluate host trees on species level and not include the whole genus, even if many species within the genus are susceptible.

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Zusammenfassung. Zwei verheerend wirkende Schadinsekten sind nach Nordamerika und Europa eingeschleppt worden: der Asiatische Laubholzbock und der Zitrusbock. Diese beiden holzbohrenden Insekten werden als größte Gefahr für unsere Baumlandschaft betrachtet, da sie ein großes Wirtsspektrum von Arten und Gattungen haben. Mit dem Versuch, eine aktuelle Zusammenstellung dieser Wirte zu kreieren, wurde eine systematische Übersicht über die Literatur mit Informationen zu den mit den beiden Laubbockkäfern befallenen Arten, die den Käfern für ihren gesamten Lebenszyklus als Wirt dienten oder als Fraßquelle genutzt wurden. Diese Übersicht enthüllte, dass eine sehr große Anzahl von Arten und Gattungen von diesen Käfern attackiert und gefressen werden. Dennoch bleibt der Eindruck nach diesen Ergebnissen unklar. Ein Grund dafür liegt in diesem Mangel an Transparenz in den veröffentlichen Studien bezüglich der bevorzugten Baumarten dieser beiden Käfer. Ein anderer Faktor, der erwähnt werden müsste, ist der Umstand, ob der Baum den ganzen Entwicklungsprozess des Bockkäfers unterstützt oder ob der nur von adulten Insekten gefressen wird. Ohne diese Informationen können Bäume mit nur moderaten Wirtseigenschaften als solche mit hervorragenden Wirtseigenschaften gekennzeichnet und somit als geeigneter Stadtbaum ausgeschlossen werden.

Resumen. Dos devastadoras plagas de insectos se han introducido en América del Norte y Europa - el escarabajo asiático de cuernos largos (ALB) (*Anoplophora glabripennis*) y los escarabajos cítricos (CLB) (*Anoplophora chinensis*). Estos dos escarabajos perforadores de la madera se argumentan ser una de las amenazas más graves para los árboles urbanos, ya que tienen un gran número de especies y géneros hospederos. Con el objetivo de crear una compilación actualizada de estos hospederos, se hizo una revisión sistemática de la literatura para obtener información sobre las especies de árboles atacados y utilizados por ALB y CLB como anfitriones para completar el ciclo de vida o para la alimentación. Esta revisión reveló que un gran número de especies de árboles y géneros son susceptibles de ser atacados por ALB y CLB. Sin embargo, con base en los resultados, el panorama aún es poco claro. Una razón de esto es la falta de transparencia en los estudios publicados con respecto a las listas de especies arbóreas susceptibles de ALB y CLB. Otro factor que debe ser reportado es si una especie de árbol soporta el ciclo de vida completo de los escarabajos o simplemente alimenta a los adultos. Sin esta información, las especies que poseen cualidades moderadas de hospedaje están en riesgo de ser etiquetados incorrectamente como muy buenos hospederos y por lo tanto excluidos como árboles urbanos.

APPENDIX 1.
Species/genera host grades for ALB according to the literature.

Full development means that a full beetle development can take place or that exit holes are present. *Feeding* means that the adult beetles feed on the tree species but there is no claim that full development can take place or that exit holes are present. *No information* means that there is no information on the type of development or investment is present.

This appendix is based on the following articles: Haack et al. 1997; Nowak et al. 2001; Lingafelter and Hoebeke 2002; Ludwig et al. 2002; MacLeod et al. 2002; Smith et al. 2002; Morewood et al. 2003; Morewood et al. 2004a; Morewood et al. 2004b; Williams et al. 2004a; Auclair et al. 2005; CFIA 2005; Morewood et al. 2005; Weilun and Wen 2005; Yang 2005; Hérard et al. 2006; Raupp et al. 2006; Ric et al. 2006; FAO 2007; Hajek and Kalb 2007; Geib et al. 2009; Natur Erhvervstyrelsen 2008; Hérard et al. 2009; Hu et al. 2009; Haack et al. 2010; Jordbruksverket 2010; APHIS 2011; Dodds et al. 2011; EPPO 2012.

[z] A detailed description of the *Populus* genus is given in Table 2.

Species	Total number of studies	Numbers of articles				Type of development		
		Resistant/ resilient	Host	Good host	Very good host	Full development	Feeding	No information
Acer buergerianum	3	1			2	1		1
Acer ginnala	2	2						1
Acer mono	3			1	2	2		1
Acer negundo	9		3		6	1		8
Acer palmatum	2	2						1
Acer pensylvanicum	2		1	1		1	1	
Acer platanoides	13		5	2	6	6		7
Acer pseudoplatanus	8		4	2	2	2		6
Acer pseudosieboldianum	1			1				1
Acer rubrum	7		2	1	4	4		3
Acer saccharinum	7		4	1	2	1		6
Acer saccharum	11		4		7	4	1	7
Acer spp.	18		6	1	11	4	1	13
Acer tegmentosum	1			1				1
Acer triflorum	1	1						
Acer truncatum	3			1	2	1		2
Aesculus hippocastanum	6		3	2	1	1		5
Aesculus ssp.	10		4	3	3	3	1	6
Ailanthus altissima	4	4						
Albizia spp.	8	2	4	1	1	4		2
Alnus spp.	7	2	4	1		2	1	2
Amelanchier spp.	1	1						
Betula nigra	2				2	1		1
Betula pendula	2		2			1		1
Betula spp.	13		5	6	2	5		8
Broussonetia papyrifera	3	2		1				1
Carpinus betulus	1		1					1
Carpinus spp.	2	1		1		1		
Carya spp.	1	1						
Catalpa bungei	2	2						
Celtis spp.	5		4	1		2		3
Cercidiphyllum spp.	2		1	1		1		1
Cercis chinensis	2	2						
Cercis spp.	1	1						
Corylus spp.	1	1						
Crataegus pinnatifida	1	1						
Crataegus spp.	1	1						
Diospyros kaki	1	1						
Elaeagnus angustifolia	2		1	1		1		1
Elaeagnus spp.	6	1	3	1	1	3	1	1

Species	Total number of studies	Numbers of articles: Resistant/ resilient	Host	Good host	Very good host	Type of development: Full development	Feeding	No information
Eucommia ulmoides	1	1						
Euonymus spp.	1	1						
Fagus spp.	3	2		1		1		
Fagus sylvatica	2		2					2
Fraxinus americana	2	2						
Fraxinus mandshurica	2	2						
Fraxinus pennsylvanicum	3		3			1		2
Fraxinus sogdiana	2	2						
Fraxinus spp.	10		8	2		3	1	6
Gleditsia spp.	2	1	1			1		
Gleditsia triacanthos	1	1						
Gingko biloba	1	1						
Gymnocladus spp.	1	1						
Hamamelis spp.	1	1						
Hedysarum spp.	1		1					1
Hibiscus spp.	7	3	3	1		1		3
Hippophae spp.	1		1					1
Juglans regia	1	1						
Juglans spp.	1	1						
Koelreuteria spp.	4	2	1		1			2
Liquidambar styraciflua	1	1						
Liriodendron chinensis	1	1						
Liriodendron tulipifera	4	3	1					1
Magnolia denudata	1	1						
Magnolia spp.	1	1						
Malus pumila	2	1	1					1
Malus spp.	6	1	5			1	1	3
Melia spp.	6	2	3	1			1	3
Melia azedarach	2	1	1					1
Metasequoia glyptostroboides	1	1						
Morus spp.	8	2	5	1			2	4
Morus alba	4	1	3					3
Ostrya spp.	1	1						
Pinus spp.	1	1						
Platanus × hispanica	1	1						
Platanus occidentalis	1	1						
Paulownia tomentosa	1	1						
Platanus spp.	15	2	6	7		5		8
Populus spp.[z]	19		8	2	9	7		12
Prunus armeniaca	1	1						
Prunus cerasifera	1	1						
Prunus salicina	1		1					1
Prunus spp.	13	2	9	2		2	1	8
Punica granatum	1	1						
Pyrus calleryana	4	4						
Pyrus spp.	9	2	6	1		1		6
Quercus alba	1			1		1		
Quercus liaotungensis	1	1						
Quercus palustris	1		1					1
Quercus rubra	4		3	1		3		1
Quercus spp.	8	7	1				1	
Rhus typhina	1	1						
Rhamnus spp.	1	1						
Robinia pseudoacacia	5	2	3					3
Robinia spp.	6	2	3	1			1	3

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Species	Total number of studies	Numbers of articles				Type of development		
		Resistant/ resilient	Host	Good host	Very good host	Full development	Feeding	No information
Rosa spp.	2		2					2
Salix babylonica	2				2	1		1
Salix matsudana	3		1		2	1		2
Salix nigra	1		1			1		
Salix spp.	18		5	2	11	6	1	11
Sambucus spp.	1	1						
Sophora japonica	1	1						
Sophora ssp.	3		3				1	2
Sorbus spp.	6		4	2		3		3
Syringa spp.	1	1						
Tilia paucicostata	1	1						
Tilia spp.	7	2	5				2	3
Toona sinensis	1	1						
Toxicodendron vernicifluum	1	1						
Ulmus americana	1		1			1		
Ulmus pumila	3		1		2	2		1
Ulmus spp.	16		6	2	8	4	1	11
Vitis vinifera	1		1			1		
Viburnum spp.	1	1						

APPENDIX 2.
Species/genera host grades for CLB according to the literature.

Full development means that a full beetle development can take place or that exit holes are present. *Feeding* means that the adult beetles feed on the tree species but there is no claim that full development can take place or that exit holes are present. *No information* means that there is no information on the type of development or investment is present.

This appendix is based on the following articles: Adachi 1994; Lingafelter and Hoebeke, 2001; Lingafelter and Hoebeke 2002; Hérard et al. 2006; Natur Erhvervstyrelsen 2008; van der Gaag et al. 2008; Vukadin and Hrasovec 2008; Haack et al. 2010; Jordbruksverket 2010; van der Gaag et al. 2010; EPPO 2012; Mattilsynet 2012; Netherlands Plant Protection Service 2012.

		Numbers of articles				Type of development		
Species	Total number of studies	Resistant/ resilient	Host	Good host	Very good host	Full	Feeding development	No information
Acacia decurrens	1		1					1
Acacia spp.	2		2			1		1
Acer campestre	2		2			2		
Acer mono	1		1					1
Acer negundo	3		3			1		2
Acer oblongum	1		1					1
Acer palmatum	3		2	1		3		1
Acer platanoides	3		3			2		1
Acer pseudoplatanus	3		3			2		1
Acer saccharinum	2		1	1		1		1
Acer spp.	11		8		3	3		8
Aesculus hippocastanum	4		4			1		3
Aesculus ssp.	2		1	1		1		1
Albizia julibrissin	1		1					1
Albizia spp.	1		1					1
Aleurites fordii	1		1					1
Aleurites spp.	1		1					1
Alnus crispa subsp. *Maximowiczii*	1		1					1
Alnus firma	1		1					1
Alnus hirsuta	1		1					1
Alnus pendula	1		1					1
Alnus sieboldiana	1		1					1
Alnus spp.	6		5	1		1		5
Aralia cordata	1		1					1
Aralia spp.	1		1					1
Atalantia buxifolia	1		1					1
Atalantia spp.	1		1					1
Betula pendula	1		1					1
Betula platyphylla	1		1					1
Betula spp.	7		6		1	1		6
Broussonetia papyrifera	1		1					1
Broussonetia spp.	1		1					1
Cajanus cajan	1		1					1
Cajanus spp.	1		1					1
Camellia oleifera	1		1					1
Camellia spp.	1		1					1
Carpinus betulus	1		1					1
Carpinus laxiflora	2		2			1		1
Carpinus spp.	5		4	1		1		4
Carya illinoensis	1		1					1
Carya spp.	1		1					1
Castanea crenata	1		1					1
Castanea spp.	1		1					

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Species	Total number of studies	Numbers of articles				Type of development		
		Resistant/ resilient	Host	Good host	Very good host	Full	Feeding development	No information
Castanopsis cuspidata var. *sieboldii*	1		1					1
Castanopsis spp.	1		1					1
Casuarina equisetifolia	1		1					1
Casuarina spp.	1		1					1
Casuarina stricta	1		1					1
Catalpa spp.	1		1					1
Cercis spp.	1		1					1
Chaenomeles spp.	2		2					2
Citrus aurantifolia	1		1					1
Citrus aurantium	1		1					1
Citrus grandis	1		1					1
Citrus limonia	1		1					1
Citrus maxima	1		1					1
Citrus nobilis	1		1					1
Citrus sinensis	1		1					1
Citrus spp.	9		5	2	2	5		4
Cornus spp.	3		2	1		1		2
Corylus avellana	2		2			1		
Corylus spp.	7		6		1	1		6
Cotoneaster spp.	5		4	1		1		4
Crataegus spp.	5		4	1		2		3
Cryptomeria japonica	1		1					1
Cryptomeria spp.	5		5			1		4
Cydonia sinensis								
Eleagnus multiflora	1		1					1
Eleagnus spp.	2		2					2
Eleagnus umbellata	1		1					1
Eriobotrya japonica	1		1					1
Eriobotrya spp.	2		2				1	1
Fagus crenata	1		1					1
Fagus spp.	6		5	1		1		5
Fagus sylvatica	1		1					1
Ficus carica	2		2					2
Ficus spp.	4		4				1	3
Fortunella marginata	1		1					1
Fortunella spp.	1		1					1
Fraxinus americana	1		1					1
Fraxinus spp.	1		1					1
Grevillea spp.	1		1					1
Hedera rhombea	1		1					1
Hedera spp.	1		1					1
Hibiscus mutabilis	1		1					1
Hibiscus spp.	3		3					3
Ilex chinensis	1		1					1
Ilex spp.	1		1					1
Juglans mandshurica	1		1					1
Juglans spp.	1		1					1
Lagerstroemia indica	1		1					1
Lagerstroemia spp.	6		4	1	1	3		3
Lindera praecox	1		1					1
Lindera spp.	1		1					1
Litchi sinensis	1		1					1
Litchi spp.	1		1					1
Liquidambar spp.	2		1	1		1		1
Maakia amurensis subsp. *buergeri*	1		1					1

Species	Total number of studies	Numbers of articles				Type of development		
		Resistant/ resilient	Host	Good host	Very good host	Full	Feeding development	No information
Maakia spp.	1		1					1
Mallotus japonicus	1		1					1
Mallotus spp.	1		1					1
Malus asiatica	1		1					1
Malus pumila	1		1					1
Malus spp.	10		8	1	1	1		9
Malus sylvestris	1		1				1	
Melia azedarach var. *subtripinnata*	1		1					1
Melia japonica	1		1					1
Melia spp.	1		1					1
Morus alba	1		1					1
Morus bombycis	1		1					1
Morus spp.	2		2					2
Olea europaea	1		1					1
Olea spp.	1		1					1
Ostrya spp.	1		1					1
Parrotis spp.	1		1					1
Persea spp.	1		1					1
Persea thunbergii	1		1					1
Pholinia benthamiana	1		1					1
Pholinia spp.	1		1					1
Pinus massoniana	1		1					1
Pinus spp.	3		3			1		2
Platanus hispanica	1		1					1
Platanus orientalis	1		1					1
Platanus spp.	9		8	1		2		7
Polygonum spp.	2		2					2
Poncitrus trifoliata	1		1					1
Poncitrus spp.	1		1					1
Populus alba	1		1					1
Populus maximowiczii	1		1					1
Populus nigra	2		2					2
Populus sieboldii	1		1					1
Populus spp.	8		8					8
Populus tomentosa	1		1					1
Prunus armeniaca	1		1					1
Prunus laurocerasus	2		2					2
Prunus mume	1		1					1
Prunus pseudocerasus	1		1					1
Prunus spp.	5		4	1		1		4
Prunus yedoensis	1		1					1
Psidium guajava	1		1					1
Psidium spp.	1		1					1
Pyracantha angustifolia	1		1					1
Pyracantha spp.	1		1					1
Pyrus hondoensis	1		1					1
Pyrus pyrifolia	1		1					1
Pyrus spp.	8		6	1	1	1		7
Quercus acutissima	1		1					1
Quercus glauca	1		1					1
Quercus robur	1		1					1
Quercus serrata	1		1					1
Quercus sessilifolia	1		1					1
Quercus spp.	5		4	1		1		4
Rhododendron spp.	3		2	1		1		2

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Species	Total number of studies	Numbers of articles				Type of development		
		Resistant/ resilient	Host	Good host	Very good host	Full	Feeding development	No information
Rhus javanica	1		1					1
Rhus spp.	2		2					2
Robinia pseudoacacia	1		1					1
Robinia spp.	2		2			1		1
Rosa multiflora	1		1					1
Rosa spp.	6		5	1		1		5
Rubus microphyllus	1		1					1
Rubus palmatus	1		1					1
Rubus spp.	2		2					2
Sageretia spp.	2		2					2
Salix babylonica	1		1					1
Salix gracilistyla	1		1					1
Salix integra	1		1					1
Salix jessoensis	1		1					1
Salix koriyanagi	1		1					1
Salix sachalinensis	1		1					1
Salix spp.	8		7	1		1		7
Sambucus spp.	1		1					1
Sapium sebiferum	1		1					1
Sapium spp.	1		1					1
Sophora spp.	2		2					2
Sorbus spp.	2		1	1		1		1
Stranvaesia benthamiana	1		1					1
Stranvaesia spp.	1		1					1
Styrax japonica	1		1					1
Styrax spp.	1		1					1
Toona spp.	1		1					1
Toxicodendron verniciflua	1		1					1
Ulmus davidiana var. *japonica*	1		1					1
Ulmus pumila	1		1					1
Ulmus spp.	5		4	1		1		4
Vernicia spp.	1		1					1
Viburnum spp.	2		2				1	1
Zelkova spp.	1		1			1		
Ziziphus spp.	1		1					1

APPENDIX 3.
The origin of the information is divided between greenhouses/laboratories, natural environments, review, or authority documents.

The number of citations is based on the Scopus database. Host-related information within the study is citations of tree suitability for ALB and CLB.

[z] Publications in Chinese with only an abstract in English
[y] Publications in German
[x] Publications in Italian
[w] Publications in Japanese

Source	Citations	Beetle	Origin of the study					Geographical focus of the publication	Host-related information within the study
			Green House/ Laboratory	Natural environments	Plantations	Review	Authority document		
Auclair et al. (2005)	9	ALB	X					New York & New Jersey, U.S.	0
MacLeod et al. (2002)	37	ALB	X					Europe	Li and Wu (1993)[z], Yang et al. (1995)[z], Gine and Chein (1986)[z]
Morewood et al. (2005)	7	ALB	X					North America	Bancroft et al. (2002), Ludwig et al. (2002)
Hu et al. (2009)	18	ALB				X		International Review	Li and Wu (1993)[z], Yan et al. (1996)[z] Gao et al. (1997)[z], Haack et al. (1997), Bao et al. (1999)[z], Li et al. (1999)[z], Lingafelter and Hoebeke (2002), APHIS (2003); Morewood et al. (2003), Li et al. (2005), Haack et al. (2006), Hajek and Kalb (2007),Masperoetal.(2007)[x],Tomiczek and Hoyer-Tomiczek (2007)[y], Zhao et al. (2007)[z]
Nowak et al. (2001)	107	ALB			X			North America	Host-related information is based on three Chinese sources and two unpublished sources from North America – He and Huang (1993)[z], Li and Wu (1993)[z], Li et al. (1999)[z]
Morewood et al. (2004a)	28	ALB	X					North America	Nowak et al. (2001)

Source	Citations	Beetle	Origin of the study					Geographical focus of the publication	Host-related information within the study
			Green House/ Laboratory	Natural environments	Plantations	Review	Authority document		
Haack et al. (2010)	40	ALB/CLB					X	International Review	ALB–Lingafelter and Hoebeke (2002), Williams et al. (2004), Wang (2004)[z], Wang et al. (2005), Yin and Lu (2005), Haack (2006), Haack et al. (2006), Hérard et al. (2006), CABI (2007), APHIS (2008), Hérard et al. (2009), Smith et al. (2009). CLB–Lingafelter and Hoebeke (2002), Hérard et al. (2006), CABI (2007)
Geib et al. (2009)	12	ALB			X			New York, U.S.	Morewood et al. (2004a), Morewood et al. (2004b), Morewood et al. (2005)
Raupp et al. (2006)	21	ALB			X			North America	Nowak et al. (2001), APHIS (2003), APHIS (2005)
Dodds and Orwig (2011)	1	ALB		X				North America	Hu et al. (2009), APHIS (2011)
Morewood et al. (2004b)	16	ALB	X					North America	Haack et al. (1997), Nowak et al. (2001), Ludwig et al. (2002), Smith et al. (2002)
Haack et al. (1997)	73	ALB				X		North America	Qin et al. (1985)[z], Sun et al. (1990a)[z], Gao et al. (1993)[z], He and Huang (1993)[z], Kucera (1996)
Williams et al. (2004)	11	ALB		X				South Korea	Luo et al. (2003), Haack et al. (1997), Wu and Chiang (1998)[z]
EPPO (2012)	Web page	ALB/CLB					X	Europe	ALB–Li and Wu (1993)[z] CLB–Gressitt (1951)
Ric et al. (2006)	-	ALB					X	Canada	Lingafelter and Hoebeke (2002), APHIS (2006)
CFIA (2012)	Web page	ALB					X	Canada	0
Yang (2005)	-	ALB				X	X	China	Sun et al. (1990b)[z], Gao et al. (1994)[z], Sun (1995)[z], Shao et al. (1997)[z], Guo (1998)[z], Li et al. (1999)[z], Wen et al. (1999)[z], Gao et al. (2002), Liu et al. (2002)[z], Li et al. (2003a)[z], Tian et al. (2003)[z]

Hérard et al. (2006)	17	ALB/CLB				X	X		Europe	0
Jordbruksverket (2012)	Web page	ALB/CLB						X	Sweden	0
Mattilsynet (2012)	Web page	ALB/CLB						X	Norway	0
Natur Erhvervstyrelsen (2012)	Web page	ALB/CLB						X	Denmark	Eppo (2012)
Hérard et al. (2009)	5	ALB			X	X			Italy	Haack et al. (1996), Hérard et al. (2006)
APHIS (2012)	Web page	ALB						X	North America	Hu et al. (2009)
Ludwig et al. (2002)	7	ALB	X						North America	Sawyer – personal communication
FAO (2007)	-	ALB					X	X	China	Lingafelter and Hoebeke (2002)
Yin and Lu (2005)	-	ALB					X	X	China	Zhou (1984)[z], Qin (1985)[z], Wang et al. (1987)[z], Li and Wu (1992)[z], Wang (1993)[z], Zhang et al. (1995)[z], Gao (1998)[z], Hu et al. (1998)[z], Cao et al. (2003)[z], Li et al. (2003b)[z], Yang (2003)[z], Zhang and Lu (2003)[z]
Morewood et al. (2003)	22	ALB	X						North America	Haack et al. (1997), Nowak et al. (2001), Ludwig et al. (2002), Smith et al. (2002)
Smith et al. (2002)	35	ALB	X						North America	Xiao (1992)[z], Nowak et al. (2001)
Hajek and Kalb (2007)	5	ALB	X						North America	Haack et al. (1997), APHIS (2005), Morewood et al. (2005)
Netherlands Plant Protection Service (2012)	Web page	CLB						X	Holland	0
Lingafelter and Hoebeke (2001)	0	CLB			X	X			Japan/Taiwan	Chang (1960), Ohga et al. (1995)
Van der Gaag et al. (2010)	2	CLB					X		Europe	Wang and Cheng (1984)[z], Qi (1997)[z], Lingafelter and Hoebeke (2002), CABI (2007), van der Gaag et al. (2008), Vukadin and Hrasovec (2008), Haack et al. (2010)

Source	Citations	Beetle	Origin of the study: Green house/ Laboratory	Origin of the study: Natural environments	Origin of the study: Plantations	Review	Authority document	Geographical focus of the publication	Host-related information within the study
Vukadin and Hrasovec (2008)	0	CLB						Croatia	Lingafelter and Hoebeke (2002)
Van der Gaag et al. (2008)	Web page	CLB				X	X	Europe (Holland)	Lingafelter and Hoebeke (2002), CABI (2007), EPPO (2006)
Adachi (1994)	16	CLB	X					Japan	Kojima and Hayashi (1978)[w]
Lingafelter and Hoebeke	Book	ALB/CLB					X	International Review	ALB–Chen and Wang (1935)[z], Zhou et al. (1981)[z], Qin et al. (1985)[z], (2002) Sun et al. (1990a)[z], Xiao (1992)[z], Gao et al. (1993)[z], He and Huang (1993)[z], Yang et al. (1995)[z], Haack et al. (1996), Kucera (1996), Haack et al. (1997), Cavey et al. (1998), Wu and Chiang (1998)[z] CLB–Clausen (1931), Kojima (1931), Cheo (1935), Gressit (1940), Gressit (1942), Gressit (1951), Lieu (1945), Samuelson (1965), Duffy (1968), Kojima and Hyashi (1978), Hua (1982)[z], Kojima and Nakamura (1986), Gao et al. (1993)[z], Hua et al. (1993)[z], Wang et al. (1996), Wu and Chiang (1998)[z]