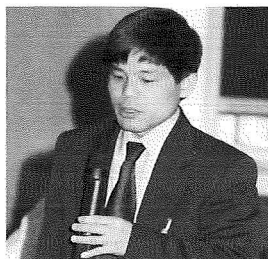


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Current situation of research and control on Poplar Longhorned Beetle, especially for *Anoplophora glabripennis* in China

Aktuelle Forschungs- und Bekämpfungsaspekte bei Bockkäfern, insbesondere zum Asiatischen Laubholzbockkäfer in China

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1 Major Poplar Longhorned Beetle (PLB) in China

Poplar is the most POPULAR tree in China, the total plantation area is about 6,6 million ha., exceeding all plantation area of other countries in the world. There exists more than 100 Poplar Longhorned Beetles (PLB) in China, but only a few species of them are destructive, and ALB is the most important PLB species in China.

2 Distribution area of ALB in China

It was realized that ALB distributed in most area of China except Tibet, Qinghai, Xinjiang, Hainan and Taiwan several years ago. However, according to latest authorized paper in 1998, ALB is not so widely distributed as reporting previously. Now, main occurrence areas of ALB in China are Shaanxi, Gansu, Shanxi, Ningxia, Inner Mongolia, Hebei, Shandong and Liaoning and so on. In Beijing, Tianjin and Qinghai, ALB occurs occasionally and partly. Not all poplar species are sensitive to ALB in some region.

Since 1980s, serious damage of ALB occurred in most northern area of China. Most of artificial forest headed by poplar and willow in some region of “Three-North (Northeast, North, Northwest China)” shelter-forest system have been completely devastated. The damage area is expanding speedy. ALB has been introduced into Western Gansu, Qinghai, even Heilongjiang now. So it is very serious potential threat to ecological environment construction of China.

“Three-North” shelter-forest system is worldly famous ecological construction, one of the six national forestry ecological engineering. It covers 42.4% territory of China. 20 million ha. plantation has been established, headed by poplar and willow trees sensitive to ALB. Key ALB disaster area includes Shaanxi, Gansu, Shanxi, Ningxia and Inner Mongolia. ALB occurring area is about 330 thousands ha. in 1994.

3 Main projects of research and control on PLB

3.1 Main research projects

In recent 20 years, research on IPM of PLB has been entering State Key Projects of Science and Technology which are supported by MOST (Ministry of Science and Technology).

3.2 IPM projects

Since 1990s, PLB IPM project has been conducted as one of the six State Engineering Management of Forest Pests (others are pine caterpillar, pine wilt nematode, rat, fall webworm and *Dendroctonus valens*) invested jointly by Finance Ministry and State Plan Commission. PLB IPM project area covers Inner Mongolia, Ningxia, Gansu and Qinghai etc., and should last many years.

4 Reasons of severe damage of ALB in China

Unreasonable cultivation and management of shelter-forest are the main reasons. Key reason of the disaster is due to large scale of poplar plantation with unitary tree species, variety, even clones susceptible to ALB. In most of the “Three North” area in China, natural environment is abominable, few local tree species grows rapidly and suitable to these areas. Thus, poplar inevitably becomes the preferred tree for its high adaptability, fast growing speed and acceptability by local people.

5 Appreciation of current control measures on ALB

5.1 Measures aimed at ALB individual

These measures include catching adults, killing eggs and young larvae with different tools, inserting poisonous stick, injecting insecticides into the excrement holes. They are easy to be operated and very effective, and only suitable in young trees, individual tree and a little area of forest, but it is very difficult to mature forest and a large scale of forest.

5.2 Measures aimed at an individual host tree of ALB

These measures include cutting down the damaged tree, spraying or injecting insecticides and biological agents on/into tree trunk to kill eggs, young larvae and adults. If initial occurrence area of ALB is only limited in small area, the measures are undoubtedly very effective when conducted continuously for a few years. However, these measures are very difficult to be carried out when ALB occurred commonly and extensively.

5.3 Measures aimed at pest population, forest and even ecosystem

These measures include rationally setting different kinds of trees in plantation, enhancing quarantine and monitor (survey and detection) ability, protecting and utilizing natural enemies. These measures are toward whole plantation, so their effects are sustainable. Thus they are the fundamental methods to control ALB disaster in China, especially silvicultural measures.

Tab. 1. Key PLB species in China

Latin name	Common name	Main host	Main damaging part of tree
<i>Apriona germari</i>	mulberry borer	poplar willow, elm, Moraceae plant, apple, berry, pear	branch and stem
<i>Batocera horsfieldi</i>	white cloudy spotted borer	poplar, willow, walnut, ash, privet, paulowina	stem
<i>Saperda populnea</i>	small poplar borer	poplar	twig
<i>Xylotrechus rusticus</i>	grey tiger longicorn	poplar, willow, oak, elm, birch	stem
<i>Anoplophora glabripennis</i>	Asia Longhorned Beetle (ALB) or glabrous spotted willow borer	poplar, willow, elm, maple	stem
<i>Anoplophora nobilis</i>	yellow spotted borer	poplar, willow, elm, maple	stem

Tab. 2. Tree types and their function to combat with ALB Disaster

Type	Feature	Example	Function
Non-host tree	Completely or basically free from ALB	<i>Fraxinus chinensis</i> , <i>Ailanthus altissima</i> , <i>Robinia pseudocacia</i> , <i>Saphora japonica</i> , <i>Elaeagnus angustifolia</i> and <i>Paulownia spp.</i>	Raising complexity of tree species in shelter-protection, strengthen stability of ecosystem
Resistant tree	Highly resistant to ALB, especially some poplars	<i>Populus bolleana</i> and <i>P. hebeiensis</i>	Be un-replaced main cultivated species in present construction of shelter-protection, mainly play ecological protection benefit.
Luring tree	The most sensitive to ALB	<i>Acer spp.</i> , <i>Populus opera</i> , <i>Salix spp.</i>	Attracting the beetle from resistant trees and killing them collectively, to protect resistant tree

6 Ecological mediation strategy and techniques on ALB

The sustainable control strategy should focus on key reason of disaster, which could be mediated artificially. In Ningxia, we have established the sustainable control system against ALB disaster, headed by ecological mediation i.e. rational setting of three types of tree species, coordinated by monitoring, biological and chemical control.

6.1 Rationally setting different types of tree in combating ALB disaster

The resistance of a tree species to a pest is relative, not absolute. In different situation (especially in varying setting of some tree species), the resistance should be obviously varied or changed. According to relative resistance of tree species, all of them divided into three types, including non-host tree, resistant tree and luring tree. Every type has its different function to sustainably "combat" with ALB.

6.2 Rational proportion of different types of tree

A rational model of different tree species setting was put forward in Ningxia, the proportion of non-host tree against resistant trees against luring trees were 45–50% : 45–50% : 5–10%.

7 Other control techniques

7.1 Quarantine

If transporting the log, seedling, cutting and SWPM relevant to ALB from epidemic area to quarantine area, they should be through strict quarantine procedure.

7.2 Management of luring tree

Contacting-breaking microcapsule has the long-lasting efficiency and can kill adult speedily. With strong anti-decomposition ability, lasting period reach 42 days. Smashing Stem Formation is a special pesticide formation with additive and deltamethrin, it kills the ALB adults by smashing a ring in stem of luring tree, and its validity lasts over 50 days.

Imidacloprid is selected as injecting insecticide that can control ALB effectively and is highly efficient and long lasting.

7.3 Biological control

The effective measures include protecting and attracting woodpecker, artificial propagation and utilization of an important and dominant natural enemy *Dastarcus helophoroides*. Key techniques for propagation of *D. helophoroides* has been developed. Releasing *D. helophoroides* beetle into forest plantation, its parasitic rate to ALB is over 59%. In addition, main pathogen of ALB are *Beauveria bassiana*, *B. brongniartii* and *Metarhizium anisopliae*, etc. Controlling ALB adults by nonwovens with *Beauveria bassiana*, mortality rate of the ALB is 38–49%.

7.4 Developing phyto-attractant of ALB

It has been researched for nearly ten years to use phyto-attractants to detect and control ALB in China. It is a very difficult project comparing with other insect attractant, although we have got some staged results.

8 Inter-specific relation between *A. glabripennis* and *A. nobilis*

Comparison of micro-structural characteristics of the adult through electronic microscope, analysis of geographical population with cluster theory, hybridization test, and genetical analysis by the means of RAPD show that the genetic relationship of *A. nobilis* and *A. glabripennis* is very close, and their differentiation is not high enough to divide them into two species. It is very important for monitoring and quarantine of them.

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