INVESTIGATIONS OF NATURAL ENEMIES FOR BIOCONTROL OF *ANOPLOPHORA GLABRIPENNIS* (MOTSCH.)

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ABSTRACT

The Asian longhorned beetle (ALB) (*Anoplophora glabripennis* Motsch.) is a recent invader to the U.S. from China, with known infestations in New York (New York City and Long Island) and Illinois (Chicago). Although ALB is currently limited in distribution within the U.S., its potential for spread into other North American landscapes at risk is alarming and demands greater attention. The only method used to control ALB in China and the U.S. at present is through the removal of infested trees, and the current emphasis of much research is directed towards eradication. However, in the event that eradication is not successful, either in the known infestations in New York and Chicago, or in as yet undetected infestations elsewhere, alternative pest management approaches must be developed. In addition, even with complete eradication, new introductions are likely to occur as a result of the challenges of interception of infested cargo. For example, current interception efforts are focused on cargo that enters the U.S. directly from China, while cargo from other countries, which in fact originated in China, is extremely difficult to track and intercept. Collectively, therefore, survey, evaluation, and mass rearing of natural enemies of ALB in China, as well as similar investigations of natural enemies of related cerambycids in the U.S., have been initiated. The objectives of this research include the identification of highly effective and host-specific, self-propagating natural enemies of ALB that possess a high potential for establishment (classical biocontrol, which tends to be the most cost effective approach for biological control), as well as those natural enemies that could be easily reared and utilized in inundative-release programs. In addition, since a long-term management goal may more realistically be to slow the ecological damage of this invader, native natural enemies (to the U.S.) that adapt to ALB and/or its host trees may be of particular interest.

Compared with other longhorned beetles, relatively few natural enemies of ALB have thus far been identified. Prior to the initiation of these studies, no egg parasitoids of ALB had been reported. On the other hand, larval parasitoids had been reported, including *Dastarcus longulus* Sharp (Coleoptera: Colydiidae), *Scleroderma guani* Xiao et Wu (Hymenoptera: Bethylidae), *Bullaea* sp (Diptera: Tachinidae), and *Megarhyssa* sp. (Hymenoptera: Ichneumonidae). Likewise, pupal parasitoids had also been reported, including *D. longulus*, *S. guani*, and *Aprostocetus* sp. (Hymenoptera: Eulophidae). Among these, *D. longulus* and *S.*

guani appeared to be the most important among these natural enemies of ALB since they were reported to be larval-pupal parasitoids.

In many areas, *D. longulus* has been reported to have parasitization rates of 50-70%. Female *D. longulus* lay eggs in frass and sawdust in a host gallery or on the host gallery wall. First instar larvae possess thoracic legs and crawl about in search of a host. Upon finding an acceptable host, the larvae lose their thoracic legs and attach to the body of its host for feeding. It is an ectoparasite, feeding singly or gregariously on its host (1-27 individuals per host), but in all cases the host is killed. *D. longulus* is considered to have the highest potential for use in biological control of ALB.

S. guani usually parasitizes longhorned beetle species whose larvae are small, ca. 15 mm in length. It is an idiobiont ectoparasitoid. Female wasps first paralyze their host by stinging, which immobilizes the host, and then lay eggs on the host body. Larvae are gregarious while developing on their host. After hosts are consumed, mature wasp larvae spin cocoons and pupate. Parental wasps remain with their young until they have completed their development and emerged as adult wasps. Should their eggs or larvae become separated from the host, parental wasps have been observed to return them to the host. Most female wasps are apterous. *S. guani* can be mass reared for biocontrol. Therefore, *S. guani* has great potential for use in the biological control of ALB larvae, specifically 1st to 3rd instars.

1999

Surveys for natural enemies were conducted in Shaanxi, Shanxi, Hebei, Xinjiang, NeiMongol (Inner Mongolia), Heilongjiang, and Shandong Provinces. As such, while over 560 ALB eggs were collected, no ALB egg parasitoids were recovered. However, four ALB larval parasitoids were found, including: *D. longulus*, *S. guani*, *Zombrus sjostedti* (Fahringer)(Hymenoptera: Braconidae), and *Megarhyssa* sp..

Initial studies of *D. longulus* resulted in parasitization rates of 25-95% in Shaanxi Province. Furthermore, these studies showed that 1-18 individual *D. longulus* completed development on a single host larva and resulted in 100% ALB larval mortality. Preliminary studies of *S. guani* showed that it could parasitize both ALB larva (3rd and 4th instar) and pupa. Preliminary studies of the biology and behavior of *Aprostocetus prolixus* LaSalle et Huang (Hymenoptera: Chalcidoidea: Eulophidae, Tetrastichinae), an egg parasitoid of *Apriona germari* (Hope)(Coleoptera: Cerambycidae), indicated that it may have potential as an ALB egg parasitoid, and thus studies were planned for 2000.

2000

A total of 1,256 ALB eggs was collected in Shaanxi, Hebei, and Ningxia Provinces, but no egg parasitoids were again identified. However, an egg parasitoid of *Batocera horsfieldi* (Hope), another important longhorned beetle pest of popular in China, was collected and appears to be a new species. Description of this species is in progress.

Studies of *D. longulus* were continued and showed that it overwinters as an adult in the crevice of old bark as well as in the soil near ALB-infected trees. A total of 650 overwintering adults were collected during this survey. Results indicated that its life span

may exceed 5 months and that it can be reared with artificial diet in 30 days. Finally, indications are that *D. longulus* population levels are lower in monocultural stands than in species rich stands. This corresponds with higher ALB population levels in monocultural stands than in species rich stands. Although studies are still in progress, results indicate that *D. longulus* may be selected as an effective biological control agent of mature ALB larvae.

Studies of the larval parasitoid, *S. guani*, resulted in the identification of an excellent substitute host for mass rearing *S. guani.* The substitute host is inexpensive and easily obtained. In addition, lab and fields experiments were conducted, and results confirmed that *S. guani* can control young ALB larvae. A parasitization rate of approximately 65% was obtained in lab studies, and field studies are still in progress.

Studies of *A. prolixus,* an egg parasitoid of *A. germeri*, indicated that this parasitoid does not diapause. While control temperature experiments showed that *A. prolixus* emergence could be adjusted to coincide with ALB oviposition and that the wasp could parasitize 20-50% of *A. germari* eggs, it did not parasitize ALB eggs. Additional studies are planned.

SUMMARY

BIIR is currently the only U.S. lab examining insect parasitoids, and several promising ALB-specific biological control agents have already been identified. The research on rearing natural enemies is an important weapon for pest management and current results are encouraging. Collectively, these studies should contribute greatly to the development of an Integrated Pest Management Program for ALB in the U.S..