Native Braconid for Biological Control of Asian Longhorn Beetle: Evaluation of Parasitism (2009-2010)

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Introduction

We surveyed native parasitoids of native cerambycid species inhabiting red maple (*Acer rubrum*) in Blackbird State Forest in central DE. From 2006 to 2010 bolts cut from infested trees were held in sono tubes in the outdoor insectary at BIIR. Parasitoids and cerambycid beetles were collected upon emergence. Parasitoids were caged on ALB-infested red maple bolts in quarantine to identify those species that parasitize and complete development on immature ALB. Results from these initial studies showed a particular Braconid species, referred to here as Brac-20, parasitizes and completes development on immature ALB (Table 1). Therefore, the **objective** of the studies reported here, conducted from 2009-2010, was to evaluate the potential of Brac-20 as a bio-control agent for ALB.

Table 1. Number of Female P_1 and Their Progeny for Each Parasitoid Species Tested from 2006-2010.

From Maple	2006		2007		2008		2009		2010	
Nomenclature	# Female P_1	# Progeny	# Female P_1	# Progeny	# Female P_1	# Progeny	# Female P_1	# Progeny	# Female P_1	# Progeny
Bethylidae sp.	0	0	0	0	0	0	2	0	0	0
Braconidae spp.	44	36	106	12	37	3	69	2	18	16
Brac-20	0	0	0	0	25	0	**628**	**77**	**352**	**726**
Chalcidoidea spp.	1	0	11	0	7	0	45	0	0	0
Hymenoptera spp.	4	0	1	0	3	0	1	0	0	0
Ichneumonidae spp.	11	0	34	0	17	0	5	0	1	0
Stephanidae sp.	0	0	0	0	0	0	1	0	0	0
Grand Total	60	36	152	12	89	3	751	79	371	742

Materials & Methods

Adult female ALB from our colony were caged on red maple bolts and allowed to oviposit. Bolts were held until they contained ALB eggs, and 1st-3rd instar larvae. These bolts were then individually placed within one gallon clear plastic jars. Newly emerged Brac-20 adults were added to the jars at 1-8 females and 0-1 males per cage (Fig.1A). The cages were maintained in a Percival PGC at 14:10 L:D, 24˚C:day, 20˚C :night, and 40-60% RH (Fig.1B). Brac-20 parental death and F_1 emergence were recorded daily. The bolt within each cage was dissected 42 days after the last female Brac-20 had died, and the # of parasitized and total ALB larvae present were collected and recorded. Any un-emerged Brac-20 cocoons (Fig.2) were carefully removed for either emergence in gel-caps or overwintering if it was late in the season.

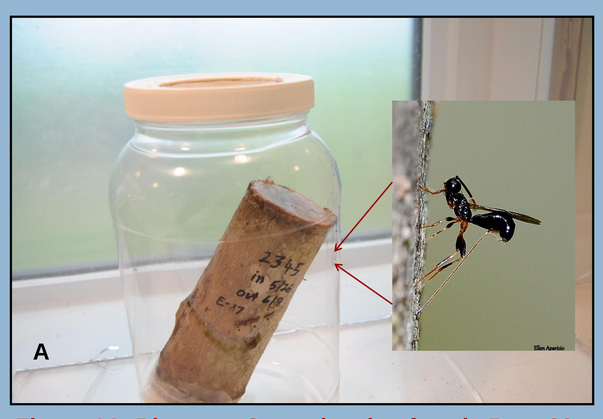

Figure 1A. Bioassay Cage showing female Brac-20.

Figure 1B. Bioassay cages in PGC

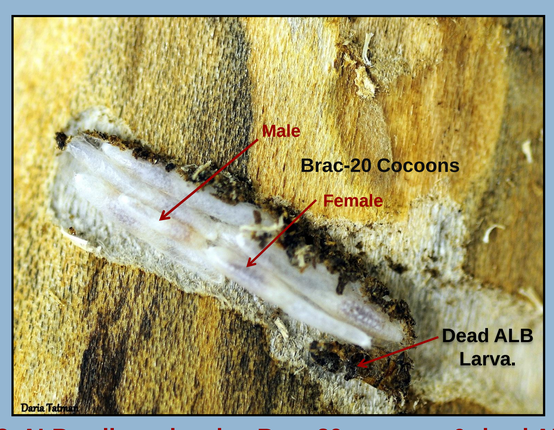

Figure 2. ALB gallery showing Brac-20 cocoons & dead ALB larva.

Results

Table 2. Production of Progeny by Brac-20 on ALB within Infested Bolts (2010)

Parental Generation	# Bioassay Cages (1 bolt / cage)	% Cages With Progeny
P_1 *	91	**41.3% (38)**
F_1	61	36.4% (21)
F_2	29	**48.9% (14)**
F_3	6	33.3% (2)
Total	**187**	**40.5% (75)**

*** Overwintering generation**

- Brac-20 underwent **4 continuous generations** on ALB within bioassay bolts under lab conditions.
- **41.3 %** of the cages containing **wild** Brac-20 (**P_1 generation**) produced progeny
- The highest percentage of cages in which progeny were produced (**48.9%**) was from the **F_2 generation**
- **90%** of the **F_3 generation** did not emerge as adults, but entered diapause as overwintering cocoons.

Table 3. Effect of the Number of Female and Male Brac-20 on Production of Progeny

Gender Combinations		# Male per Cage 0	# Male per Cage 1	Overall Mean *
# Female per Cage	1	7.4 (8) *	6.9 (10)	**7.1 (18)**
	2	9.4 (11)	4.2 (9)	**7.1 (20)**
	4	8.5 (8)	9.3 (8)	**8.9 (16)**
	6	**10.4 (11)**	**11.7 (10)**	**11.0 (21)**
Total		9.2 (38)	8.1 (37)	8.6 (75)

*** Mean number progeny produced per cage (# cages)**

- Production of progeny per cage gradually increased with increasing numbers of female Brac-20/cage.
- Mean # of progeny per cage was highest for cages containing 6 parental female Brac-20

Table 4. Effect of Number of Female and Male Brac-20 on % Parasitism *

		# Male per Cage 0		# Male per Cage 1		Overall Mean	
		% Parasitism / Cage (# total larvae)	% Parasitism per Female	% Parasitism / Cage (# total larvae)	% Parasitism per Female	% Parasitism / Cage (# total larvae)	% Parasitism per Female
# Female per Cage	1	2.8 (459)	**2.8**	5.3 (399)	**5.3**	4.0 (858)	**4.0**
	2	5.3 (358)	**2.6**	4.1 (444)	**2.1**	4.6 (802)	**2.3**
	4	3.5 (373)	**0.9**	9.0 (234)	**2.3**	5.6 (607)	**2.8**
	6	12.8 (258)	**2.1**	19.7 (239)	**3.3**	16.1 (497)	**2.7**
Total		5.4 (1,448)		8.1 (1,316)		6.5 (2,764)	

*** Percent parasitism = number of larvae parasitized by Brac.-20 / total # of larvae present at dissection.**

- Percent parasitism per female gradually decreased with increasing numbers of female Brac-20/cage, suggesting the potential interference among females within the cage. This was consistent in the presence and absence male Brac-20

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- Percent parasitism per female was significantly greater in the presence of a male Brac-20, but only in the presence of a single female.

Discussion

Brac-20 is a **gregarious idiobiont ectoparasitoid** of ALB (Fig. 3A) and native cerambycid larvae (Fig. 3B); overwinters as cocoons in host galleries; and appears to undergo 3 generations/yr. All have **positive implications to population increase of Brac-20.**

Both 'wild' Brac-20 (P_1 generation) and those developing on ALB (F_1, F_2, F_3) successfully parasitize and kill ALB larvae, with **positive implications to natural biological control, as well as to mass rearing and release of Brac-20.**

Interference or competition among adult female Brac-20 within cages may reduce parasitism rate per female. However, in nature, female Brac-20 may be more likely to partition the available resource to avoid contact with sisters, and thereby **increase the rate of parasitism at the population level**.

Collectively, results are promising. Research is ongoing to determine life history traits, searching ability, and rates of parasitism of Brac-20 as a potential biological control agent of ALB. Methods for mass rearing and release are also ongoing.

Figure 3. Parasitized ALB (A) and native cerambycid larvae (B).

Figure 4. Brac-20 mating in a gel-cap.

Acknowledgements
We thank Jeff Wildonger, USDA ARS BIIRU, for his help with felling trees for this research. We thank James Dobson, Northern Regional Forester Delaware Department of Agriculture Forest Service, for allowing us to use many red maple trees along with conducting research activities in Blackbird State Forest.