The Inheritance of a Black Body Mutant of
Biosteres longicaudatus (Hymenoptera: Braconidae)
from Hawaii[1]

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ABSTRACT

A black body mutant, *bl-b*, of the braconid parasitoid, *Biosteres longicaudatus* (Ashmead), is described. The inheritance pattern indicates that the trait is determined by a single recessive gene.

The braconid larval parasitoid, *Biosteres longicaudatus* (Ashmead) was imported to Hawaii during the late 1940s to help control the oriental fruit fly, *Dacus dorsalis* (Hendel), and the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Bess et al. 1961, Clausen et al. 1965). *B. longicaudatus* is one of the few imported fruit fly parasitoids to become successfully established in Hawaii (Bess et al. 1961) and might be useful in a future inundative release program to suppress tephritid fruit fly populations (Wong et al. 1984).

Genetic investigations of *B. longicaudatus* have not been reported to date. We herein describe the first heritable mutant, black-body color *(bl-b)*, for *B. longicaudatus*.

MATERIALS AND METHODS

One of us (J. Nishimoto) found a single black-bodied *B. longicaudatus* male in a laboratory colony of normal, reddish body individuals. This black-body male was isolated and mated to 3 red-body (+) females in the initial parental (P) generation. Offspring were obtained, sexed as virgin adults, then crossed in succeeding generations. Crosses were designed to isolate a pure-breeding colony of black-bodied *B. longicaudatus*. The two phenotypes, black and red body color, are easily distinguishable for both sexes and no color intergrades were obtained. A pure-breeding colony was obtained beginning in the F5 generation.

Genetic interpretations were postulated to account for the observed color and sex distribution pattern, and each was evaluated for goodness-of-fit by chi-square test analysis. Significant deviations from a 50:50 overall ratio, especially in favor of females, are routinely observed in our normal laboratory colonies of *B. longicaudatus* and are believed to depend upon the size of the host larvae at the time of parasitization (T.T.Y. Wong, unpub. data). Therefore, overall sex ratios were not considered important in interpreting the present data.

RESULTS AND DISCUSSIONS

The results from five generations of crosses appear in Table 1. Offspring from the initial black-body ♂ crossed to normal (red-bodied) ♀♀ were all red-bodied indicating that the black-body trait is recessive. Inbreeding the F1 resulted in red and

TABLE 1.   Observed numbers of red-body (+) and black-body (bl-b) *Biosteres longicaudatus* parasitoids by sex (Hawaii, 1985).

Generation	Phenotypes			
	black-body (bl-b)		red-body (+)	
	♂♂	♀♀	♂♂	♀♀
P	1	–	–	3
F1	0	0	22	43
F2	0	54	50	63
F3	126	176	305	629
F4	118	227	0	26
F5	487	915	0	0

black-bodied F2 ♂♂, but only red-bodied F2 ♀♀. The absence of F2 black-bodied ♀♀ is consistent with the expectation that ♂♂ are haploid (single set of genes inherited maternally) and arise from unfertilized eggs, while ♀♀ are diploid and arise from fertilized eggs (Doutt, 1959). However, these results are also consistent with ♂♂ diploidy if black-body is sex-linked (e.g., gene on X chromosome) and sex is determined by an XX (♀♀) — XY or XO (♂♂) mode of inheritance. Cytological evidence would be needed to resolve these two possibilities.

In the F3, red and black bodied parasitoids were obtained from crosses between black-body ♂♂ (F2) and red-body ♀♀ (F2). The overall pheoptypic ratio observed is consistent with the black body trait being determined by a single gene recessive since the expected 3 red-body: 1 black-body was obtained (X_1^2 (H_0=3:1) = 0.21, p>0.05 for both sexes combined). However, statistically significant (p<0.05) excesses of red-bodied ♀♀ (X_1^2=4.11) were observed, compared to the expected 3:1 ratio. Rare chance events appear to be the best explanation for these two sexually opposing deviations.

Only black-bodied ♀♀ and ♂♂ were chosen to mate in the F3 generation, yet some red-bodied F4 progeny were produced. This result meant that either the black-body trait could show full dominance some of the time in heterozygous ♀♀, or that some black-body ♀♀ chosen as parents had already mated with sibling red-bodied ♂♂. The later explanation appears to be the case since the F5 and several succeeding generations have yielded only black-bodied progeny from black-bodied parents (Table 1). A genetic interpretation of the foregoing appears in Figure 1.

Because the black-body trait appears to breed true and is easily distinguishable, it has potential usefulness in further genetic or ecological studies. For example, releases of genetically marked black-bodied *B. longicaudatus* would permit one to estimate native parasitoid population size by release-recapture methods, as well as to assess the field reproductive potential of released parasitoids by progeny analysis.

Generation	Genotypes ♂♂	Genotypes ♀♀	Notes
P Cross	b1-b|	+|+	Single black ♂ found and crossed to red ♀♀
F1 Progeny	+|	+|b1-b	All red ♂♂ and ♀♀
F1 Cross	+|	+|b1-b	
F2 Progeny	+| , |b1-b: +|+ ,	+|b1-b	Red and black ♂♂, all red ♀♀
F2 Cross	b1-b|	+|b1-b	
F3 Progeny	+| , |b1-b: +|b1-b ,	b1-b|b1-b	Red and black ♂♂ (expect ¼ black) / Red and black ♀♀ (expect ¼ black)
F3 Cross 1.	b1-b|	b1-b|b1-b	Desired cross of virgin F3 ♀♀
F3 Cross 2.	+|	b1-b|b1-b	Accidental cross of non-virgin F3 ♀♀
F4 Progeny 1.	b1-b|	b1-b|b1-b	All black ♂♂ and ♀♀
F4 Progeny 2.	b1-b|	+|b1-b	All black ♂♂; All red ♀♀
F4 Cross	b1-b|	b1-b|b1-b	All black ♂♂; All red ♀♀
F5 Progeny	b1-b|	b1-b|b1-b	All black ♂♂ and ♀♀

+ = dominant red-bodied gene, b1-b = recessive black-bodied gene

FIGURE 1. A genetic interpretation of the black-body (b1-b) and red-body (+) traits based upon the results shown in Table 1 (Hawaii, 1985).

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