

LIFE HISTORY OF *CTENOCOLUM JANZENI*
(COLEOPTERA: BRUCHIDAE) IN SEEDS OF
PISCIDIA MOLLIS (LEGUMINOSAE)

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ABSTRACT

Ctenocolum janzeni females glue their eggs to the surface of the indehiscent fruits of *Piscidia mollis*. The larvae, upon hatching, enter the fruit directly beneath the egg, consume about 0.75 of a seed while molting several times and then pupate inside a single seed. The adults leave through the seed coat and then the pod valve. Under optimum conditions, and as long as seeds are available, *C. janzeni* continues to reproduce in culture. At least 3 generations were completed and 29.9% of the seeds collected were consumed. No parasitoids were reared from any of the cultures. It is suggested that, because *Piscidia mollis* occurs in fairly dense stands, host and host plant scarcity due to diversity and spatial distribution does not account for the lack of parasitoids. The parasitoids may be absent because (1) we are observing a period after a drastic reduction in the bruchid population and the parasitoids have not yet returned; or (2) the coevolutionary race has been temporarily won by the bruchids due to a buildup of resistance by the bruchids to parasitoids.

INTRODUCTION

As with several recent taxonomic revisions of New World Bruchidae, the paper by Kingsolver and Whitehead (1974) has made available names for bruchids that have much interesting ecological and behavioral data compiled for them. These data, when published, can be compared and many basic biological theories put forth to account for host preferences, host specificity, coevolution, etc. This is the case with *Ctenocolum janzeni* Kingsolver and Whitehead, which spends its larval life in the seeds of *Piscidia* spp. (Table 1). I am specifically concerned here with the interrelationships between *C. janzeni* and *Piscidia mollis* Rose.

C. janzeni has a distribution from Sonora and Tamaulipas, Mexico, to Puntarenas, Costa Rica. Presumably all of its hosts are in the genus *Piscidia*. According to Kingsolver and Whitehead (1974) all known hosts for species of *Ctenocolum* are in the legume genera *Piscidia*, *Lonchocarpus*, *Muelleria*, and *Bergeronia*. According to Heywood (1971) the first 3 genera are in the subtribe Lonchocarpeae, tribe Dalbergieae, and, contrary to Kingsolver and Whitehead (1974), who place it in Lonchocarpeae, *Bergeronia* is in the subtribe Aeschynomeneae, tribe Hedysareae.

METHODS

The rearing data in this paper were accumulated using the methods of Johnson (1970). In this paper C. D. Johnson is abbreviated CDJ.

Table 1. Host plants and collection localities of *Ctenocolum janzeni*.

Old Records: Kingsolver and Whitehead, 1974: *Piscidia grandiflora* (Donn. Sm.), *P. mollis* Rose, *P. carthagensis* Jacq.

New Records: *Piscidia mollis*: Mexico. Sonora: ca 400', Lake Mocuzari, 22-XII-76 (CDJ #140-76, #142-76); ca 500', 8 mi S Lake Mocuzari, 22-XII-76 (CDJ #150-76); 21 mi NW Alamos, 23-XII-76 (CDJ #160-76).

Table 2. Emergence data for *Ctenocolum janzeni* in fruits of *Piscidia mollis* as of 16-VII-77

| <u>Culture #</u> | <u>Date Emerged By</u> | <u>Number of Bruchids Emerged</u> |
|------------------|------------------------|-----------------------------------|
| 140-76 | 31- I-77 | 14 |
| | 23- II-77 | 20 |
| | 30-III-77 | 30 |
| | 27- IV-77 | 56 |
| | 25- V-77 | 5 |
| | 16-VII-77 | 34 |
| 142-76 | 31- I-77 | 5 |
| | 23- II-77 | 4 |
| | 30-III-77 | 8 |
| | 27- IV-77 | 16 |
| | 25- V-77 | 10 |
| | 26- V-77 | 2 |
| | 16-VII-77 | 19 |
| 150-76 | 23- II-77 | 6 |
| | 2- V-77 | 8 |
| | 25- V-77 | 1 |
| | 26- V-77 | 1 |
| | 16-VII-77 | 29 |
| 160-76 | 23- II-77 | 19 |
| | 31-III-77 | 7 |
| | 2- V-77 | 66 |
| | 25- V-77 | 7 |
| | 26- V-77 | 2 |
| | 16-VII-77 | 119 |

Table 3. Percentage infestation of seeds of *Piscidia mollis* by *Ctenocolum janzeni* as of 16-VII-77.

| <u>Culture #</u> | <u>number of seeds</u> | <u>number of bruchids</u> | <u>percent infestation</u> |
|------------------|------------------------|---------------------------|----------------------------|
| 140-76 | 346 | 159 | 45.9 |
| 142-76 | 176 | 64 | 36.4 |
| 150-76 | 475 | 45 | 9.5 |
| 160-76 | <u>635</u> | <u>220</u> | <u>34.6</u> |
| Total | 1632 | 488 | 29.9 |

RESULTS AND DISCUSSION

According to Shreve and Wiggins (1964), *Piscidia mollis* is a tree 3-9 m tall with a rounded, moderately dense crown; with pods (fig. 1) 2-10 cm long, 3.5-5 cm wide, 1-6-seeded, indehiscent, 2-winged on each suture, the wings several times as broad as the body, the pods breaking transversely with age (fig. 2A); and the seeds (fig. 3) are buff, about 1 cm long and 4-5 mm wide. My observations agree with theirs except that the seeds vary to dark brown. Most pods have 3-4 seeds in them and the seeds are separated from each other by ingrowth of the pod valves. The mature dry fruits remain on the trees for several weeks. The tree grows on dry hillsides, bajadas, and near streamways from near Ures southward to Alamos, Sonora, in the inner foothills. Kingsolver and Whitehead (1974) report records from within the above range and southward into Sinaloa. I have observed it to be locally abundant in areas disturbed by agriculture and grazing near Lake Mocu-zari and Alamos. Most likely the unique winged segments (fig. 2A), each containing a seed, are dispersed by the wind.

Piscidia is a fabaceous legume in the tribe Dalbergieae, subtribe Lonchocarpeae (Heywood 1971). The genus *Lonchocarpus* is the only other plant genus in this subtribe known to harbor bruchids in northwestern Mexico. The related genera *Muelleria* and *Pterocarpus* are known hosts for bruchids in South America and Costa Rica (Kingsolver and Whitehead 1974; J. M. Kingsolver, *in litt.*).

All 4 samples of *P. mollis* seeds collected in 1976 (Table 1) were fed upon by *C. janzeni* (Table 2). Two samples of seeds from the same general vicinity were collected in February 1973 but no bruchids were reared from them nor were there bruchid eggs nor bruchid damage. This is an example of patchy infestations by bruchids, not an unusual phenomenon. All fruits in the 6 samples were mature when collected.

Several seeds and fruits fed upon by *C. janzeni* were examined and then dissected to learn something about the behavior and ecology of *C. janzeni*. Eggs are oviposited singly or in groups on the lateral margins of the pod valves and on the wings (figs. 2e, 4e). (One exposed seed in a culture had eggs (fig. 3e) on it.) The eggs are attached directly to the pod with a small amount of adhesive beneath the egg (fig. 4e). The larvae burrow directly from the egg, through the pod wall, and enter a seed. A small amount of frass is left behind in the empty egg chorion. Several eggs may be laid on the pod valve above a seed but only one adult emerges from a seed, indicating that cannibalism most likely occurs among the larvae.

The larvae consume about 0.75 of a seed, molting several times in the process. Their frass and cast skins are used to line the inside of the seed, which serves as a pupal chamber. The adults emerge through a typical, round exit hole in the side of the pod valve (figs. 1, 2B, C). Often several seeds in the same pod are fed upon by different individuals of *C. janzeni* (fig. 1).

The first emergence from seeds was noticed about one month after the seeds were collected (Table 2) and emergence continued for about 6 months. The peaks of emergence for culture 140-76 and 160-76 were near

May 1 and July 16. This species is a continuous breeder, and the peaks of emergence represent a second and third generation in culture. Presumably, under optimum conditions in nature, this tropical species continues to feed in the seeds of its host as long as the seeds are available since the bruchids are still active in all 4 cultures as of 1 Sept. 1977. Probably the pod sections break apart under natural conditions and wings on each section allow some seeds to be dispersed before all are destroyed.

A fairly high percentage of the seeds of *P. mollis* are destroyed by *C. janzeni* (Table 3). The seeds collected at Lake Mocuzari and northwest of Alamos (140-76, 142-76, 160-76) were much more heavily infested than was the other culture. Even so, an overall percentage infestation of 29.9 is high compared to bruchids in *Nissolia* (Johnson 1978a), *Condalia* (Johnson 1978b), and *Cassia* (Johnson and Slobodchikoff 1978). There are no obvious morphological differences between pods in the 4 cultures, so perhaps the differences in percentage infestation may be attributed to a low initial infestation or possibly to differences in amounts of toxic chemicals in seeds between plants.

No other seed-feeding insects or parasitic Hymenoptera were reared from these cultures, although the eggs may be parasitized (fig. 4e). A bruchid population which lacks parasitoids is not a unique event (Johnson and Kingsolver 1971; Janzen 1975), rather it seems to be common for many tropical bruchids to be free of parasitoids (Janzen 1975). Janzen (1975) attributes the relative freedom from parasitoids for tropical bruchids in Guanacaste Province, Costa Rica, to a number of factors. One factor is that bacterial disease organisms feed on some bruchid larvae and perhaps feed on the parasitoid or outcompete it. Another factor is that in a habitat with a great deal of diversity (i.e., tropical Guanacaste) there are many more species of bruchids in a greater diversity of seeds, therefore it is more difficult for parasitoids to find the fewer bruchids of each species. Thus, being higher in the food chain, the parasitoids must use a greater diversity of hosts or specialize in order to survive. Consequently, any major disturbance to the habitat will have a proportionally greater effect on organisms higher in the food chain. Therefore, if a seed crop is not produced in a given year then the bruchid population will theoretically go to extinction or be drastically reduced. The specialist parasitoid will almost certainly become extinct and will be the last to recolonize an area after seed crops are produced and the bruchids have returned. The generalist parasitoid will theoretically be affected only if all or most of its hosts are reduced in number because it has alternative hosts.

The lack of parasitoids in bruchids in seeds of *P. mollis* is difficult to explain because *P. mollis* is common in southern Sonora and may be locally abundant. If the trees were widely dispersed then this lack of parasites could be explained on the difficulty of a parasitoid finding enough suitable bruchid hosts. Because the trees are locally abundant, in theory, at least, parasitoids should have colonized the bruchid population and reached an equilibrium with them if lack of diversity is one of the major criteria for parasitism.

It is possible that what appears to be a circumstance where there are no parasitoids at any point in time is merely a period of time after a drastic reduction of the bruchid population and the parasitoids have not yet recolonized that area.

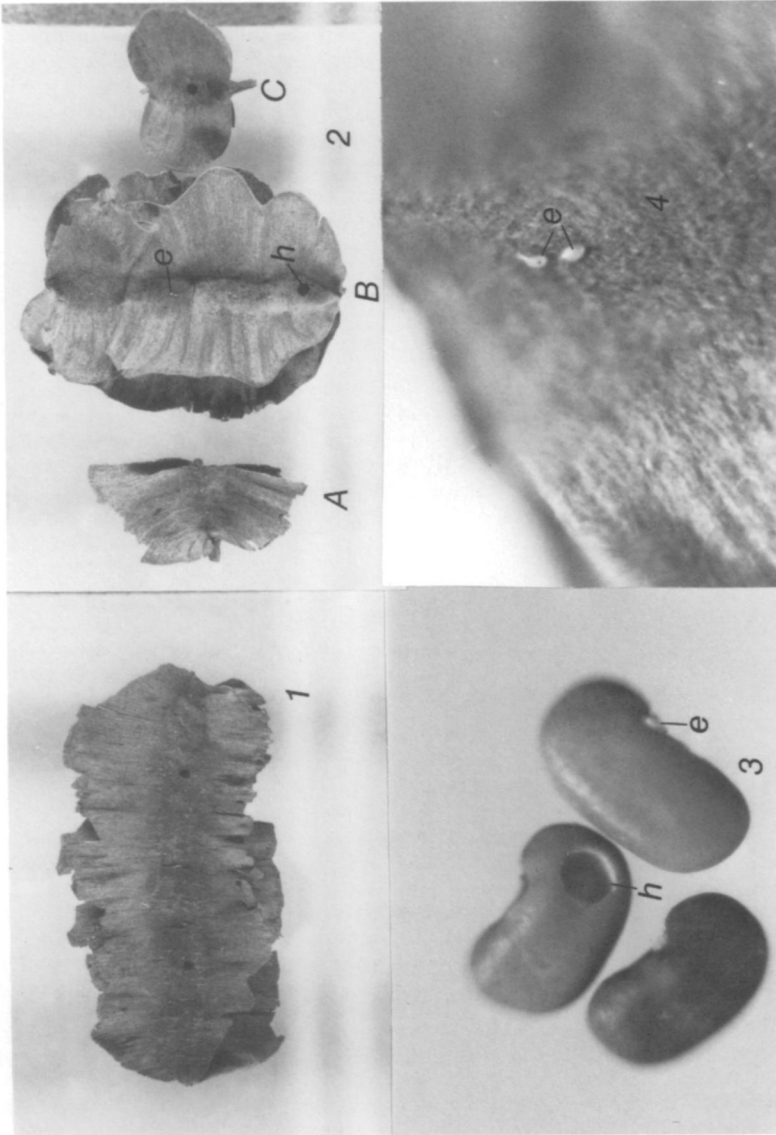


Fig. 1: Mature winged fruit of *Piscidia mollis* with 2 exit holes of *Ctenocolum janzeni* in the fruit valve. Fig. 2: A, Winged segment of fruit of *P. mollis* containing a seed and resulting from a transverse break in fruit; B, Entire fruit with 4 seeds, eggs (e) and exit hole (h) of *C. janzeni*; C, One-seeded fruit of *P. mollis* with exit hole of *C. janzeni*. Fig. 3: Seeds of *P. mollis* with egg (e) and exit hole (h) of *C. janzeni*. Fig. 4: Eggs of *C. janzeni* glued to surface of pod of *P. mollis*.

Because populations of bruchids and their parasitoids are in a co-evolutionary race with each other, it is very possible that at any point in time we are observing a mere segment of a change that is occurring in nature. Perhaps what we see when bruchids (or seeds for that matter) are not preyed upon by parasitoids is that the coevolutionary race has been temporarily won by the bruchids (or seeds) through physiological or ecological resistance. Presumably, in time, the parasitoids will re-establish themselves in *C. janzeni* and the coevolutionary race will begin again.

I have offered several possibilities to explain the lack of parasitoids in *C. janzeni*. Hopefully these will be of heuristic value in stimulating more research on this interesting phenomenon.

ACKNOWLEDGMENTS

I am grateful to Margaret and Rod Johnson for assisting with the field work and to Ellen Conroy and Joel Floyd for laboratory and curatorial assistance. I thank J. L. Strother for identifying the plants for me. Partial support for collecting was provided by the Insect Identification and Beneficial Insect Introduction Institute, U.S. Department of Agriculture under Grant 12-14-100-9970 (33).

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