Bionomics, thermal requirements and fertility life table of *Doryctobracon areolatus* under different thermal conditions

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Introduction

Doryctobracon areolatus (Szépligeti, 1911) (Hym. : Braconidae) is a larval-pupal koinobiont endoparasitoid and is widely distributed in Neotropical regions, occurring from Mexico to Argentina. In Brazil, several studies have shown that *D. areolatus* is the species that most often parasitizes on larvae of different species of the genus *Anastrepha* and *Ceratitis capitata*.

Studies conducted under field conditions have shown that the parasitism rate of *D. areolatus* ranged from 32.3 to 63.4% varying according to the tree species used as a host. Results obtained under laboratory conditions show that the average parasitism rate in papaya fruit infested with larvae of *A. fraterculus* is approximately 53%.

Although the results show the potential use of *D. areolatus* as an agent for biological control, information on abiotic factors that influence their biology is scarce. It is known that temperature can affect different biological aspects of insects, for example, fertility, sex ratio, longevity, life cycle and viability of different developmental stages. In addition, the knowledge of insect thermal requirements provides control for laboratory rearing, development of models for studies of ecological zoning, as well as estimates for field releases. In this sense, this study investigated the biology of *D. areolatus* aiming to determine thermal requirements and fertility life table at different temperatures using larvae of *A. fraterculus* as hosts.

Figure 1. Female of *D. areolatus* performing parasitism in the larvae of *A. fraterculus* in papaya fruit.

Material and Methods

The biology of *D. areolatus* was studied in chambers at temperatures 18, 20, 25, 28 and 30°C, relative humidity (RH) 70±10% and a photophase of 12h.

Immature development was investigated at all temperatures studied, and the puparia were observed daily to determine the emergence time of males and females of *D. areolatus*. The emergence data allowed to determine the percentage of parasitoids emerged, the average duration of egg-adult period as well as the sex ratio for each temperature studied. In addition, it was determined the base temperature (TT) and thermal constant (K) for males and females. The experiment was conducted in a completely randomized design with six treatments and 100 repetitions in which each larva of *A. fraterculus* was considered as a repetition (experimental unit).

To adult stage, larvae were exposed to parasitoids for 24 h and then were transferred to plastic pots containing the artificial diet. When the first puparium was formed, the larvae were transferred to acrylic vials containing extra-fine vermiculite as substrate for pupation. After emergence, the total number of parasitoids and flies was counted and intact pupae were dissected to check for the presence of non-emerged parasitoids. The total number of parasitoids, emergence rate, daily and cumulative parasitism, sex ratio (number of females/males + females) and longevity of males and females were evaluated.

Results and Discussion

Table 1. Duration of egg-adult period (means ± SE) for males and females and sex ratio of *D. areolatus* at different temperatures.

Temperature (ºC)	Development time (days) [a]		Sexual ratio [b]
	Males	Females	
18	41.31 ± 0.35 a	44.26 ± 0.15 a	0.41 a
20	29.00 ± 0.26 b	32.47 ± 0.14 b	0.48 a
25	19.25 ± 0.19 c	21.85 ± 0.23 c	0.49 a
28	17.86 ± 0.16 d	19.61 ± 0.20 d	0.55 a
30	17.40 ± 0.45 d	19.26 ± 0.20 d	0.60 a

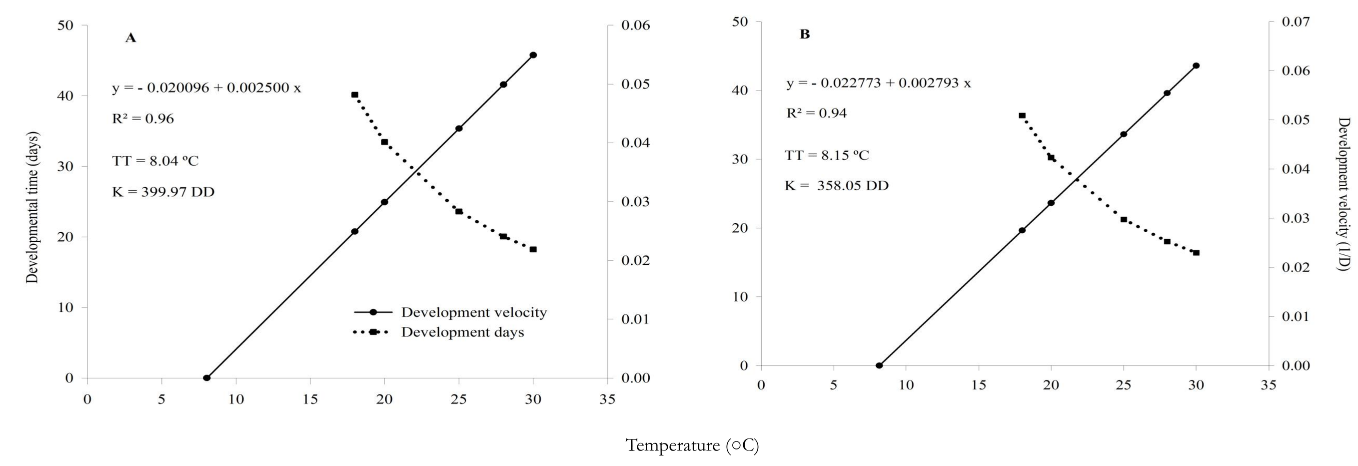

Figure 2. Rate curve of egg-adult period of *D. areolatus* at different temperatures. (A) Females, and (B) Males.

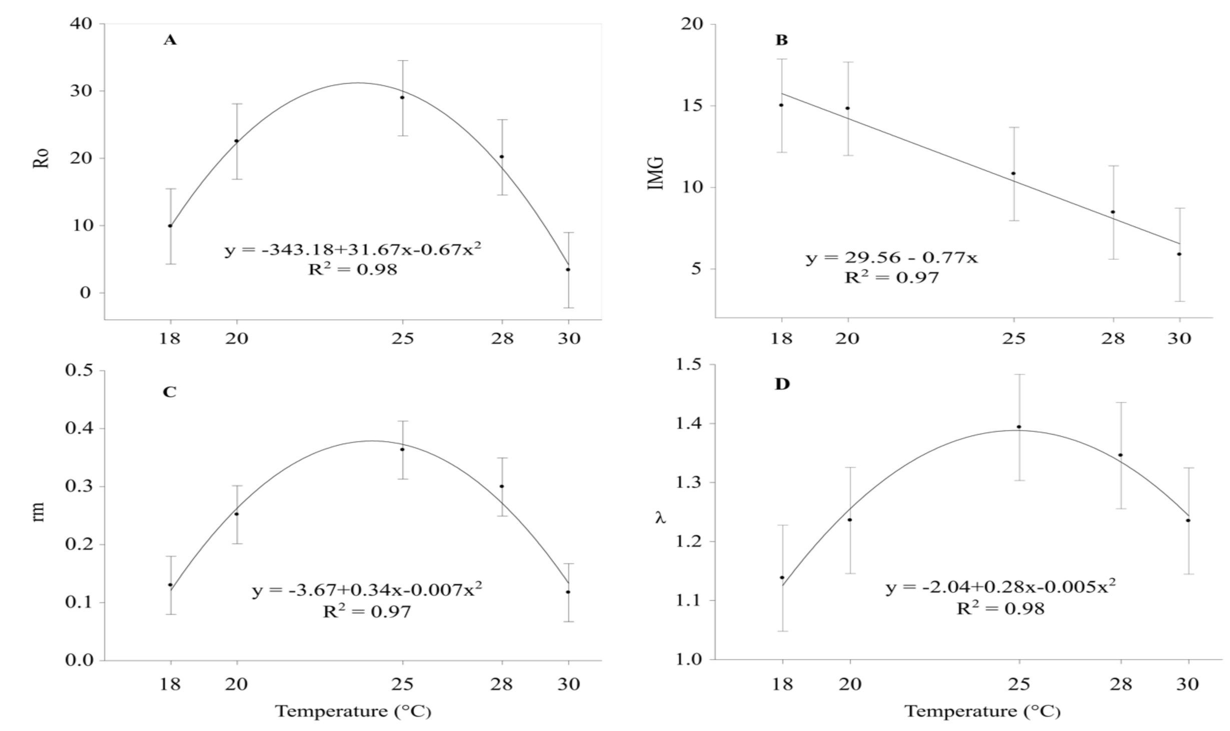

Figure 3. Regression models used to describe the influence of temperature on life-table parameters of *D. areolatus*. (A) Net reproductive rate. (B) Intrinsic rate of increase. (C) Finite rate of increase. (D) Mean generation time. Vertical bars represent confidence bars.

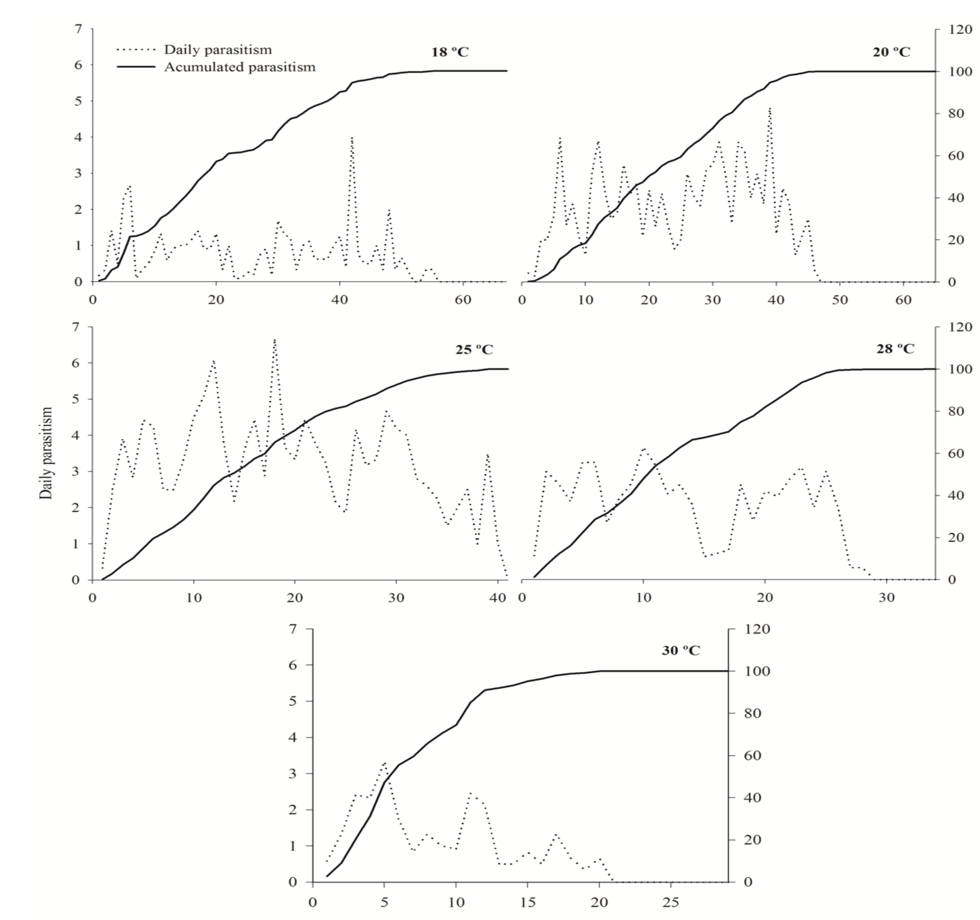

Figure 4. Daily and cumulative parasitism of *D. areolatus* in larvae of *A. fraterculus* at different temperatures.

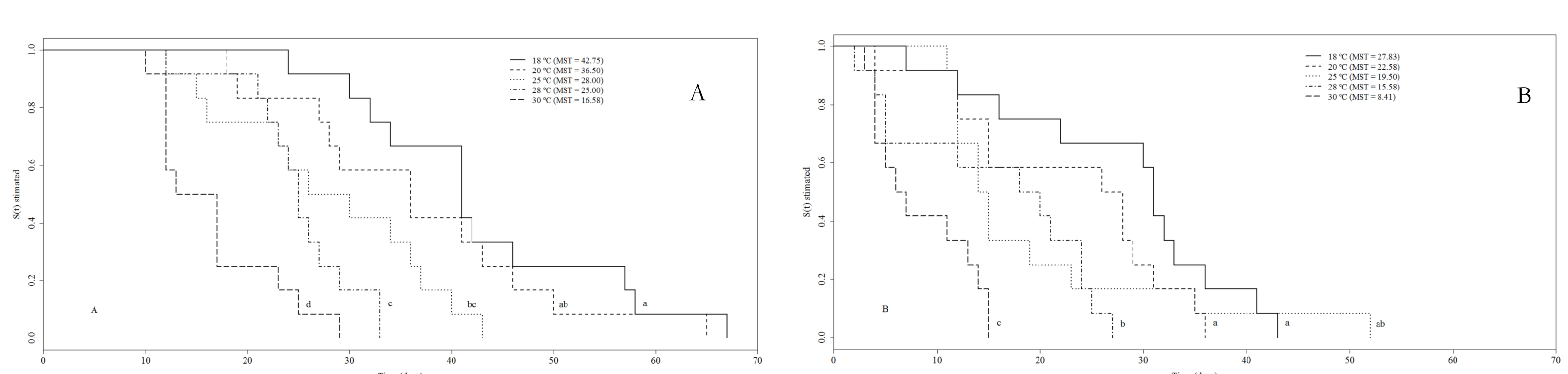

Figure 5. Survival curves of *D. areolatus* kept at different temperatures. (A) Females, (B) Males. Curves followed by different letters differ statistically from each other by the *t*-test (P< 0.05). Mean Survival Time (MST).

Conclusion

The results obtained in this study showed that mild temperatures (18-25°C) were more favorable for the immature development of *D. areolatus* since the percentage of insect emergence at temperatures of 28 and 30°C was lower than at other temperatures studied. Furthermore, the immature were able to develop into a broad gradient of temperature (18-30°C). These results suggest that *D. areolatus* presents advantages in relation to their heterospecifics regarding rearing in the laboratory and thermal plasticity under field conditions.

Acknowledgments

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