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Ceratitis captata (Wied.) Thoracic Conformation Reared in Cashew Apple (*Acardium occidentale*) †

Tayron Sousa Amaral [1,*], Rodrigo de Souza Bulhões [2], Fernando Ribeiro Sujimoto [3] and Elton Lucio de Araujo [4]

[1] Universidade Federal Rural de Pernambuco, Departamento de Agronomia, Recife, Pernambuco, Brasil
[2] Universidade Federal da Bahia, Departamento de Estatística, Salvador, Bahia, Brasil; rsbulhoes@gmail.com
[3] Universidade de São Paulo, Escola Superior de Agricultura "Luiz de Queiroz", Piracicaba, São Paulo, Brasil; fsujimoto@gmail.com
[4] Universidade Federal Rural do Semi-Árido, Mossoró, Rio Grande do Norte, Brasil; eltonl@ufersa.br.
* Correspondence: tayron.amaral@gmail.com
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Abstract: Among all fruit flies species, *Ceratitis capitata* (Wied.) (Diptera: Tephritidae) is one of the main pest for fruits, infesting a wide range of hosts. However, there is not deep knowledge about its potential infestation and development in fruits from Caatinga (semi-arid) biome in Brazil. Thus, we aimed to evaluate the thoracic conformation of *C. capitata* adults (males and females) from two strains reared in cashew apple (*Anacardium occidentale* L.). For this, it was taken measurements from the thorax of 25 couples fed on different diets: (a) strain V8 in cashew apple; (b) wild strain in cashew apple; and (c) V8 in artificial diet. Since the damages are not normaly distributed, it was applied tests of medians differences to compare the results based on a 5% level of significance. For the adults from the two strains reared on cashew apples, the medians of thoracic measurements are higher than the males. In the adults from artificial diet, the median of the males was considerably higher than the females. Among the males, it was possible to verify the proximity of the thoracic measurements medians from the observations of the two strains reared in cashew apples. Such two strains showed lower measurements when compared to the diet reared ones. The V8 strain presented higher thoracic conformation to the tested food, showing to be more adapted to the cashew apple.

Keywords: fruit flies; morphometry; cashew apple; Caatinga

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1. Introduction

There are two important fruit fly genera found in Brazil, *Anastrepha* Schiner and *Ceratitis* MacLaey. Both genera can be characterized as part of the most important obstacles to the production and exportation of fruits in the country [1]. *Ceratitis capitata* (Wied.) is a cosmopolitan species which, in Brazil, represents the only species from this genus, being responsible for the most serious damages in fruits, since it is quite polyphagous [2,3]. Besides the anthropic action, their fast development and new territory reach were facilitated by the presence of native hosts, which eventually become a way to maintain the populations when there are no preferential hosts.

The females lay the eggs inside of the fruits, where the whole immature stage develop. The embryonic development of *C. capitata* under 25°C takes 48 hours [4,1]. After hatching, the larva develops in the inner part of the fruit and, by feeding on pulp, the fruits become improper to consume or even to any industrializing process [5]. The larval stage period takes 10-17 days, while the pupal takes 9-12 days, depending on the conditions where they are exposed [4,1].

In the Northwest region of Brazil, the fruit flies can find several hosts, such as guava (*Psidium guajava* L.), umbu (*Spondias tuberosa* L.), juá (*Ziziphus joazeiro* Mart.) and others

[5,6]. Among the exotic hosts of *C. capitata* found in this region, there are mango (*Mangifera indica* L.) and papaya (*Carica papaya* L.), both exponentially growing as important fruits for exportation [7]. Moreover, native fruits as cajarana (*Spondias* sp.) and cashew (*Anacardium occidentale* L.), which are part of the regional market, are characterized as potential hosts for the fruit flies [7].

The acclimatization in new environments and hosts can bring serious damages to the region, mainly when the host is relevant to the regional market, as it happens for the cashew and cajarana in the semiarid region of Brazil. For Ceará state, the biggest cashew nuts producer, for example, if a *C. capitata* infestation happens it would definitively result in serious losses. Therefore, the goal of this investigation was to evaluate the morphological aspects of adults from two *C. capitata* strains, Vienna 8 and wild, along the artificial infestation on cashew fruits.

2. Materials and Methods

The populations of the strains were kept under laboratory conditions and the fruits were artificially infested by introducing eggs inside them. From the adults emerged after this process, 25 couples were selected from each treatment in order to take the thorax measures. The adults were obtained by immatures that developed in different diets: V8 strain in cashew; wild strain in cashew; and V8 in artificial diet.

The appendices from all individuals were removed by tweezers, placed on a Petri dish and taken to observation, measurement and images collection by Leica DMC 2900 digital camera attached to Leica CH-9435 microscopy. The thorax was measured between the head insertion and the scutel.

The data were submitted to Shapiro normality test. Since this investigation deal with non-normal data, it was ran the non-parametric test of Kruskal-Wallis variance analysis. Confidence intervals to the median were simulated by bootstrap method with 10 thousand replications. The statistical analysis were ran in R Core Team [8]. It was adopted the 5% significance level in this study.

3. Results

The distribution of adults thorax measures presented similar medians when compared the two strains developed on cashew fruits. The highest value was found in Vienna 8 reared in artificial diet. However, the measures amplitudes from flies reared in cashew fruits were lower (Fig. 1).

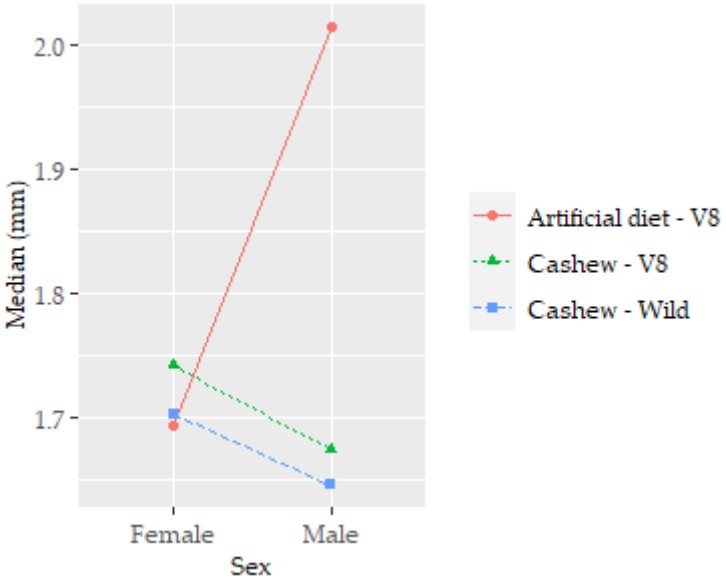

Figure 1. Distribution of Ceratitis capitata thorax measures from Vienna 8 (V8) and Wild strains developed in different diets (25° ± 2°, 60% RU).

The distribution of males and females thorax measures presented similar results. However, the males amplitudes were higher than the females, indicating that the males present a higher variability (Fig. 2). The variation coefficient (V.C.) of females thorax measures distribution (4.7%) was lower than the males (11.1%), indicating homogeneity. In other words, the distribution of females thorax measures is more concentrated close to its mean.

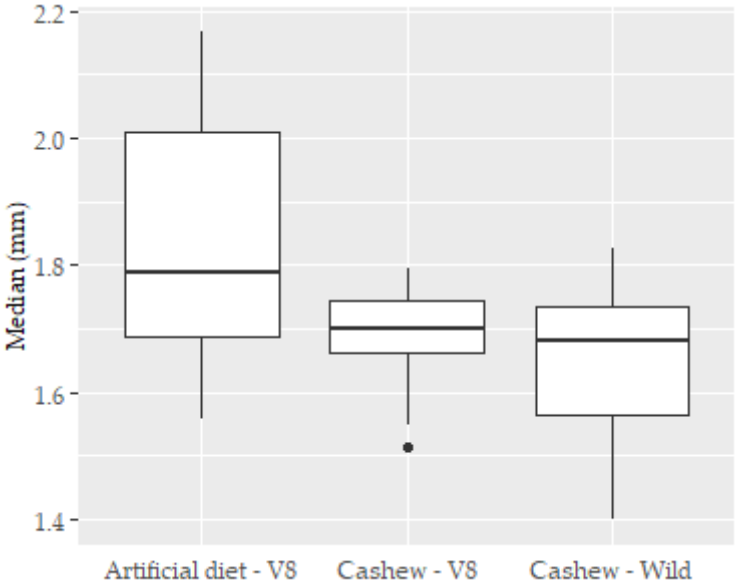

Figure 2. Medians of the males and females thorax measures of *Ceratitis capitata* from Vienna 8 (L. V8) and Wild strains developed in different diets (25° ± 2°, 60% RU).

To the adults from both strains reared in cashew fruits, the medians of the female thorax measures were higher than the males. The values for males and females from Vienna 8 were 1.675 and 1.742, respectively; while the values for the wild strain were 1.646 and 1.703, respectively. For the adults emerged from the larva that developed in the diet, the median of the males thorax measures was considered higher (2.014) than the females (1.693). From the analysis of simulated intervals to the median with 95% of confidence, there was no evidence of statistical significative difference between the medians of the males and females thorax measures for the wild strain (Table 1).

Table 1. Medians of males and females thorax of *Ceratitis capitata* from Vienna 8 and wild strains reared in different diets (25° ± 2°, 60 RU) and correspondent intervals simulated with 95% of confidence by bootstrap with 10 thousand replications.

Sexy	Strain	Diet	Medians	C.I. 95%
Male	Vienna 8	Artificial	2.014	(1.961, 2.096)^{a}
Female	Vienna 8	Artificial	1.693	(1.664, 1.724)^{bc}
Male	Vienna 8	Cashew	1.675	(1.652, 1.702)^{c}
Female	Vienna 8	Cashew	1.742	(1.724, 1.762)^{b}
Male	Wild	Cashew	1.646	(1.543, 1.789)^{bc}
Female	Wild	Cashew	1.703	(1.636, 1.775)^{bc}

Among the males, there was a proximity in the medians of the thorax measures from the cashew fruits observations of both strains. These two measures were considerably lower than the median of the thorax measures from flies reared in artificial diet. Among

females, there was a higher proximity for the medians of the thorax measures from the wild strain reared in cashew fruits and the Vienna 8 reared in the artificial diet. Both were slightly lower than the medians of the thorax measures from Vienna 8 developed in cashew. Evaluating the simulated intervals to the median with 95% of confidence, there was no evidence of differences in the medians of thorax measures between the females from the two strains in the tested diets, nor between the males from the two strains from the cashew diet.

4. Discussion

The length of the insects bodies is a factor influenced by several agents, from genetic to environmental (e.g. temperature, humidity, nutrition). It is actually a differential point during the mating choice by the females, indicating the high fitness of the individuals and, consequently, presenting a higher chance of survival [9, 10]. Although, there is no consensus about it, since several investigations presented distinct results about the real preference for bigger males and the lack of association between these aspects and the mating selection [9, 10, 11, 12].

In this study it was observed the variation of the *C. capitata* thorax, fruit flies developed in native fruit from the Brazilian semiarid. It was observed that males from Vienna 8 strain reared in artificila diet were bigger (2.014 mm) all the other specimens evaluated in this investigation, regardless the strain, sex and substrate where they developed. However, there was no difference among females from Vienna 8 strain reared in artificial diet (1.693 mm) and the other groups. The difference between males (1.675 mm) and females (1.742 mm) from the Vienna 8 strain was also observed to the specimens reared in cashew fruits, even though the males presented the lower length recorded to all the groups. About the wild strain, there was no difference between males and females.

Some studies have shown the importance of the males length body to the females choice during the mate, evidencing that bigger males are preferred by the females while mating. They also show that the origin of males (reared in laboratory or coming from the wild) does not influence this decision, regardless in laboratory, semi-field or cages in the field [13, 14, 15]. [13] demonstrated that the size of the thorax in *C. capitata* is a factor directly linked to the mating success, showing that the bigger the thorax length, the higher the chances of being chosen by females during the mating behavior. They also observed that the males wing length does not represent a relevant factor to the female selection, but it is actually a characteristic associated as a collateral effect of the thorax length. Comparatively, the data obtained in this investigation indicate the cashew fruits influenced the development of males from Vienna 8 with a significantly lower thorax length when compared to the females from the same strain, also females and males from the wild strain. On the other hand, males developed in the artificial diet presented the higher length of such structure, showing that the quality of the fruit do not well attend the body development of adult insects.

In conclusion, the results obtained in this study show that cashew fruits are not suitable hosts to *C. capitata* development, which presented a lower thorax length when compared to the ones reared in artificial diet.

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