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Some biological parameters and colonization of *Aleurodicus cocois* on dwarf-cashew

Algunos parámetros biológicos y colonización de Aleurodicus cocois *en marañón*

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ABSTRACT

The aim of this study was to investigate the biology and colonization of *A. cocois* on dwarf-cashew seedlings. Levels of colonization were scored on a scale ranging from 0 to 4, and biology was established by evaluation of oviposition and reproductive parameters. Egg incubation time was 7.1 ± 0.88 days, first, second, third and fourth instar nymph phases lasted 5.9 ± 1.54, 6.8 ± 2.02, 5.2 ± 1.93 and 8.1 ± 2.69 days, respectively, egg-to-adult development took 33.1 ± 4.06 days, adult longevity was 14.3 ± 5.52 days and female fecundity was 43 ± 8.5 eggs female^{-1}. Peak colonization occurs within 190 days.

Key words: *Anacardium occidentale,* biological parameters, cashew whitefly.

RESUMEN

Este estudio tuvo como objetivo investigar las características biológicas y la colonización de A. cocois *en marañón. La biología fue evaluada examinando los parámetros de oviposición y reprodución y la colonización fue evaluada con el uso de una escala de puntuaciónde 0 a 4. La duración del desarrollo embrionario fue de 7,1 ± 0,88 días, siendo la duración del primer, segundo, tercero y cuarto ínstares ninfales de 5,9 ± 1,54, 6,8 ± 2,02, 5,2 ± 1,93 y 8,1 ± 2,69 días, respectivamente. El ciclo desde huevo a adulto requiere, en promedio, 33,1 ± 4,06 días. La longevidad promedio del adulto fue de 14,3 ± 5,52 días y la fertilidad promedio de las hembras fue de 43±8,5 huevos/hembras^{-1}. La colonización máxima ocurre dentro de los 190 días.*

Palabras clave: Anacardium occidentale, *parámetros biológicos, mosca blanca.*

Introduction

Aleurodicus cocois (Curtis, 1846), commonly known as the giant whitefly because of its large size in comparison with other genera of the subfamily, is a major pest of cashew *(Anacardium occidentale* L.) in Brazil. This whitefly is widespread in all cashew growing areas of northeastern Brazil, producing sporadic but severe infestations that cause significant losses in productivity (Mesquita and Braga-Sobrinho, 2013). However, *A. cocois* is not restricted to Brazil, but can be found infesting avocado *(Persea americana* Mill.), mango *(Mangifera indica* Linn.), apricot *(Prunus armeniaca* Linn.), guava *(Psidium guajava* Linn.), pomegranate *(Punica granatum* Linn.), passion fruit *(Passiflora incarnata* Linn.) and some ornamental species in Chile and Peru (Núñez, 2008; Núñez *et al.,* 2008).

Whiteflies have the potential to inflict direct damage by inoculating toxins while feeding on phloem sap, giving rise to anomalies or phytotoxic disorders characterized by wilting and yellowing of leaves and branches (Liu *et al.,* 2012).

In spite of the wide range of plant hosts that may be subject to attack by the cashew whitefly, and the potential damage that it can cause, this insect has received little attention from researchers. The sparsity of information is of particular importance because the biology of *Aleurodicus* spp. can vary according to the host plant as well as the ambient temperature and humidity. The aim of the present study was, therefore, to investigate the biology and colonization of *A. cocois* on dwarf-cashew clone. The results of this study will contribute to the more efficient management of the pest and the minimization of losses in productivity currently incurred by cashew farmers.

Materials and Methods

The experiments were carried out in the Entomology Laboratory at "Embrapa Agroindústria Tropical" (Fortaleza, CE, Brazil). The population of *A. cocois* was collected in an experimental field of "Embrapa" (4°10'35"S; 38°28'19"W; altitude 79 m) and reared on dwarf-cashew seedlings (clone BRS189) in netted cages maintained under controlled conditions (28±1° C; 70±10% relative humidity; 14 h photophase) in an insect breeding room.

The colonization experiment was conducted with laboratory-reared insects, by about six generations, and dwarf-cashew seedlings of clone CCP76 under the conditions described above. Ten cashew seedlings (six months old) were placed in a cage constructed from wire mesh and voile cloth (1 m x 1 m x 1 m) and each was infested with 20 non-sexed adult whiteflies. Subsequently, the process of colonization was observed over a six month period by careful examination of 10 leaves (replicates) per plant. The formation of whitefly colonies on each cashew leaf was recorded according to a scale from 0 to 4 (Goiana *et al.,* 2017) as follows: 0 - leaf free of infestation; 1 - initiation of colonies on the abaxial surface of the leaf; 2 - developing colonies on the abaxial surface of the leaf; 3 - abaxial surface of the leaf completely colonized; 4 - fully colonized leaf with adaxial surface darkened by sooty mold.

For biology experiments, five cashew seedlings were placed separately in cages constructed from wire mesh and voile cloth (40 cm high x 17 cm diameter) and each was infested with 20 adult female white flies. Adults were sexed using morphological characteristics. Males can be easily identified by their elongate genital parts (shaped like a forceps) on the end of abdomen (Arruda, 1971). Oviposition was evaluated after 24 h by counting the number of eggs laid on each plant, following which egg incubation time and viability were determined along with the duration times of the nymphal phases and egg-to-adult development. In order to estimate female fecundity, 20 non-sexed adult whiteflies were transferred three days after emergence to three healthy cashew seedlings and the number of eggs laid was recorded daily. Sex differentiation was performed on dead insects at the end of the experiment in order to establish the number of eggs laid per female per day. Longevity (days) was determined by observing 15 non-sexed adult whiteflies from the time of their emergence until their death. Data were expressed in the form of mean ± standard error.

Results and Discussion

Oviposition and initiation of colony formation (defined as the first level of infestation with score 1 could be observed one day after whiteflies had been transferred to dwarf-cashew seedlings. The second level of infestation (score 2) was recorded between 45 and 60 days after transfer when 100% of the examined leaves exhibited developing colonies, while complete colonization of leaves (score 3) was attained between 135 and 150 days after infestation. Full colonization with growth of sooty mold (score 4) took between 175 and 190 days.

These results are of direct importance in the management of this pest, since an understanding of the different infestation levels, along with the length of time required by the insect to attain each level, is crucial in establishing appropriate control measures. Pest management should begin when infestation levels are low and the colonies are still developing (scores 1 and 2), since control is far more difficult, or even unattainable, when the insect population has increased and severe symptoms of infestation have become apparent on the host. In tropical and subtropical regions, where *A. cocois* can reproduce continuously (overlaping generations), monitoring and early detection of plant colonization is essential for effective control.

Development from egg-to-adult took 33.1 ± 4.06 days on average, while the longevity of adult insects was 14.3 ± 5.52 days. The complete life cycle of the cashew whitefly from eggs to death of adults was established at 47.4 ± 9.58 days (Table 1).

Table 1. Development of *Aleurodicus cocois* on leaves of dwarf-cashew clone CCP76 under controlled laboratory

conditions (28 ± 1 °C, 70 ± 10% relative humidity and 14 h photoperiod).

Developmental phase	Duration (days)	Viability (%)
Egg incubation	7.1 ± 0.88	80.9 ± 6.28
First instar nymph	5.9 ± 1.54	87.5 ± 4.88
Second instar nymph	6.8 ± 2.02	91.2 ± 2.91
Third instar nymph	5.2 ± 1.93	90.1 ± 3.02
Fourth instar nymph	8.1 ± 2.69	83.9 ± 8.40
Egg-to-adult	33.1 ± 4.06	48.8 ± 5.10
Adult (longevity)	14.3 ± 5.52	–

The female whitefly lays eggs *(ca.* 0.2 mm in length) in a *spiral* pattern among a white powdered wax on the abaxial surface of leaves. Immediately after oviposition the eggs are pale in color but acquire a dark yellowish hue as they mature. The nymph emerges through a longitudinal opening in the corium of the egg at its widest portion. First instar nymphs are hyaline in appearance, mobile and tend to settle and feed in areas close to the site of oviposition. Newly formed second instar nymphs are translucent, inactive and more waxy in appearance than the first instar. Regardless of developmental phase, the nymphs possess seven pairs of dorsal glands, from which emerge seven pairs of vitreous brittle wax filaments that rise appreciably over the back of the nymph. These filaments are most visible in third instar nymphs onwards. The ceriferous hairs around the nymphs increase in number and become darker yellow in color during the last nymphal stages, while fourth instar nymphs are characterized by the initial presence of ceriferous fringes. The adult whitefly emerges through an inverted T-shaped longitudinal slit and initially remains immobile. After around three days, the newly emerged adults are covered with powdered wax and soon start visiting other leaves to feed and lay eggs.

Gondim and Sales (1981) reported reproductive parameters of *A. cocois* reared on anon-commercial giant cashew under laboratory conditions at 26 ± 2 °C as follows: pre-oviposition period of 3.4 days, egg incubation time of 8.83 ± 0.59 days, durations of first, second, third and fourth instar nymphal phases of 6.17 ± 0.60, 7.50 ± 2.83, 5.50 ± 0.73 and 8.50 ± 2.83 days, respectively, and a complete life cycle of 52.6 days. While these values were similar to those observed in the present study, the mean egg viability (90.98 ± 5.96%) recorded by these authors was higher than that observed in the present study (80.9 ± 6.28%), and the average longevity of adult whiteflies (16.14 ± 1.96 days) was somewhat longer than the value reported herein (14.3 ± 5.52 days). Such variations in reproductive parameters probably result from differences in the characteristics of the host plants that influence the development of the pest, and in the higher temperature employed in the present study, which would lead to a higher posture rate (number of eggs deposited per female) and more rapid development (Toscano *et al.,* 2016).

Regarding fecundity, female cashew whiteflies laid 43 ± 8.5 eggs female^{-1} (at 28 ± 1 °C) on the dwarf-cashew clone CCP76, suggesting that *A. cocois* is considerably less fertile than other members of the Aleyrodidae such as *B. tabaci* biotype B, which laid 160 and 98 eggs female^{-1} (at 26 ± 1 °C) on leaves of soybean and common bean, respectively (Musa and Ren 2005). This finding explains why *A. cocois* takes around twice as long to colonize plants as its family counterpart *B. tabaci.*

Most of the biological parameters of *A. cocois* on dwarf-cashew clone CCP76 described herein resemble those obtained for other species of *Aleurodicus* that infest unrelated host plants in different geographical settings, indicating that members of the genus share common biological characteristics. For example, Taravati and Mannion (2016) reported reproductive parameters of *A. rugioperculatus* Martin reared on ornamental wild banana *(Strelitzia nicolai* Regel & Korn) under the conditions prevailing in Florida, USA, as follows: pre-oviposition period of 2.7 ± 0.27 days, fecundity of 34.5 ± 8.4 eggs female^{-1}, male longevity of 4.3 ± 0.9 days, female longevity of 5.9 ± 0.8 days, and egg-to-adult viability of 29 ± 4%. Thus, in comparison with *A. rugioperculatus, A. cocois* presented longer adult longevity and higher fecundity and egg-to-adult viability. According to Aishwariya *et al.* (2007), the reproductive parameters of *A. dispersus* Russel reared on guava *(Psidium guajava* Linn.) varied between the dry (summer) season and the rainy (winter) season with respective values as follows: egg incubation time of 5.54 ± 0.22 and 9.2 ± 0.62 days, adult longevity of 10.94 ± 0.41 and 13.78 ± 1.10 days, and female fecundity of 50.2 ± 5.16 and 47.92 ± 5.90 eggs female^{-1}. Thus, only the fecundity of *A. cocois* was lower than that of *A. dispersus* independent of season.

Conclusion

Dwarf-cashew clone CCP 76 is a suitable host for the development of *A. cocois,* rendering the plant susceptible to attack by this pest in the field, similar to non-commercial giant cashew. Levels of infestation of dwarf-cashew clone CCP76 by *A. cocois* in northeastern Brazil should be manageable up as soon as its occurrence is detected. Over the time, the increase in pest density would make control difficult and, most likely, unattainable.

Literature Cited

Arruda, E.C. 1971. Contribuicáo ao estudo de *Aleurodicus cocois* Curtis, 1846 (Homoptera: Aleyrodidae) e seu controle biológico em Pernambuco. Escola Superior de Agricultura Luiz de Queiroz/ESALQ. Brazil, 70 pp.
[Links]

Aishwariya, K.K.; Manjunatha, M.; Naik, M.I. 2007. Biology and host range of spiralling whitefly. *Karnataka Journal of Agricultural Sciences,* 20 (1): 149-152. [Links]

Goiana, E.S.; Dias-Pini, N.S.; Gomes Filho, A.A.H.; Chagas Neto, F.V.; Barros, L.M.; Pastori, P.L.; Duque, F.J.S. 2017. Preferencia de clones de cajueiro-anáo á mosca-branca e distribuicáo temporal da praga e seu predador. *Boletim de Pesquisa e Desenvolvimento,* Fortaleza: Embrapa Agroindústria Tropical, 123, 15 p. [Links]

Gondim, M.T.P.; Sales, F.J.M. 1981. Ciclo biologico da mosca branca do cajueiro *[Anacardium occidentale, Aleurodicus cocois]. Fitossanidade,* 5 (1): 38-40.

Liu, S.S.; Colvin, J.; Barro, P.J. 2012. Species concepts as applied to the whitefly *Bemisia tabaci* systematics: how many species are there? *Journal of Integrative Agriculture,* 11 (2): 176-186. [Links]

Mesquita, A.L.M.; Braga-Sobrinho, R. 2013. Pragas e doencas do cajueiro. In: Araújo, J.P.P. (Ed.). Agronegócio caju: práticas e inovacoes. Brasilia: Embrapa Agroindústria Tropical, pp. 195-215. [Links]

Musa, P.D.; Ren, S.X. 2005. Development and reproduction of *Bemisia tabaci* (Homoptera: Aleyrodidae) on three bean species. *Insect Science,* 12 (1): 25-30. [Links]

Núñez, E. 2008. Plagas de paltos y citricos en Perú. In: Ripa, R.S.; Larral, P. Manejo de plagas en paltos cítricos. Chile: Instituto de Investigaciones Agropecuarias, pp. 324-364. [Links]

Núñez, E.; Iannacone, J.; Gómez, H. 2008. Effect of two entomopathogenic fungi in controlling *Aleurodicus cocois* (Curtis, 1846) (Hemiptera: Aleyrodidae). *Chilean Journal of Agricultural Research,* 68 (1): 21-30. [Links]

Taravati, S.; Mannion, C. 2016. Effect of aggregation and cage setting on some life-history parameters of *Aleurodicus rugioperculatus* (Hemiptera: Aleyrodidae). *Journal of Economic Entomology,* 109 (1): 249-254. [Links]

Toscano, L.C.; Aguirre, W.M.; Tomquelski, G.V.; Maruyama, W.I.; Gouveia, G.C.C.; Dias, P.M. 2016. Dinámica populacional de mosca-branca, incidencia do mosaico dourado do feijoeiro e alternativas de controle da praga no "cultivo das secas" no cerrado. *EntomoBrasilis,* 9: 18-25. [Links]

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