# Notas Científicas

# *Amblyseius largoensis* in controlling red palm mite under semi-field conditions

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Abstract – The objective of this work was to evaluate the efficiency of two *Amblyseius largoensis* (Acari: Phytoseiidae) populations in controlling *Raoiella indica* (Acari: Tenuipalpidae). The treatments were: release of *A. largoensis* from the island of La Réunion; release of *A. largoensis* from the state of Roraima, Brazil; and a control, without predator release. Initially, 20 predators were released per plant; three other releases were done at a rate of ten adults per plant, at 46, 135, and 156 days after the first release. The population densities were estimated every 20 days, during six months. Both *A. largoensis* populations evaluated are not sufficiently efficient to control the *R. indica* population.

Index terms: *Raoiella indica*, biological control, coconut, quarantine pest.

# *Amblyseius largoensis* no controle do ácaro-vermelho-das-palmeiras em condições de semicampo

Resumo – O objetivo deste trabalho foi avaliar a eficiência de duas populações de *Amblyseius largoensis* (Acari: Phytoseiidae) no controle de *Raoiella indica* (Acari: Tenuipalpidae). Os tratamentos foram: liberação de *A. largoensis* da ilha de La Réunion; liberação de *A. largoensis* do Estado de Roraima; e controle, sem liberação de predadores. Inicialmente, 20 predadores foram liberados por planta; outras três liberações de dez adultos por planta foram feitas aos 46, 135 e 156 dias após a primeira liberação. A densidade populacional foi estimada a cada 20 dias, durante seis meses. Ambas as populações de *A. largoensis* avaliadas não são suficientemente eficientes para controlar a população de *R. indica*.

Termos para indexação: *Raoiella indica*, controle biológico, coco, praga quarentenária.

The red palm mite, *Raoiella indica* Hirst (Acari: Tenuipalpidae), is a serious invasive pest of palms and banana reported in the Americas since about 10 years ago. Nowadays, it has spread to Brazil, the Caribbean Islands, Colombia, Mexico, USA, and Venezuela (Etienne & Flechtmann, 2006; Vásquez et al., 2008; Carrillo et al., 2011). In Brazil, it is considered a quarantine pest and has been reported in the states of Roraima (Navia et al., 2011) and Amazonas (Rodrigues & Antony, 2011). *Raoiella indica* has a high potential to establish itself and to cause serious ecological and economic impacts in the country, particularly on coconut, banana, native palms, and flowers of the Heliconiaceae family (Amaro & Morais, 2013).

Biological control has been considered the best method for the management of this pest (Moraes et al., 2012). The mite phytoseiid *Amblyseius largoensis* (Muma) (Acari: Phytoseiidae) has been frequently associated with this pest on coconut (Gondim Jr. et al., 2012). However, during field evaluations in the Americas, it has been found that the native populations of *A. largoensis* are not sufficiently efficient to control *R. indica* (Carrillo & Peña, 2012; Gondim Jr. et al., 2012). Therefore, surveys have been conducted to discover prospective biological control agents in the Western Hemisphere, specifically in the Middle East and South Africa, where *R. indica* possibly originated (Dowling et al., 2012). In 2011, a population of

DOI: 10.1590/S0100-204X2016000500030

*A. largoensis* from La Réunion Island was introduced in the state of Roraima, Brazil, and the results obtained in the laboratory suggested that this population is more efficient to control *R. indica* than the native one (Domingos et al., 2012; Moraes et al., 2012).

The objective of this work was to evaluate the efficiency of two *Amblyseius largoensis* (Acari: Phytoseiidae) populations in controlling *Raoiella indica* (Acari: Tenuipalpidae).

The experiment was conducted at Embrapa Roraima, in the municipality of Boa Vista, in the state of Roraima, Brazil, in a screen house covered with a transparent plastic. One population of *A. largoensis* used in the study was collected from coconut (*Cocos nucifera* L.) leaves taken from different regions of La Réunion Island, and the other, from the urban area of Boa Vista. The colonies were established on leaflets of *Adonidia merrillii* (Becc.) BecC. (=*Veitchia*) (Arecaceae) kept in a Petri dish (16 cm in diameter) with a wet polyethylene foam disc. The margin of the leaflets was covered with wet hydrophilic cotton, and the predators were fed with *R. indica*. The colonies were maintained at 27ºC, at 60±10% relative humidity, under 12:12 hours light:dark.

Fifteen coconut seedlings of the green dwarf variety, about 1.0 m high and with three to four unexpanded leaves, planted in a polyethylene pot, were used. One hundred adult females of *R. indica* were transferred to each seedling. Twenty-four hours after the release, the following treatments were established: release of *A. largoensis* from La Réunion Island; release of *A. largoensis* from the state of Roraima; and a control, without predator release. The seedlings of each treatment were put separately inside cages covered with white voile, and 20 adult predators were released per plant. Since the population of predatory mite was low, three other releases were done, at a rate of ten adults per plant, at 46, 135, and 156 days after the first release.

The densities of eggs, post-embryonic immatures, and adults of *R. indica*, as well as of post-embryonic immatures and adults of *A. largoensis* were counted, with a 20× hand lens, every 20 days within a period of 6 months. To estimate the mite density per square centimeter, 60 coconut seedling leaves of the same age as those used in this experiment were measured with photoelectric equipment model LI-3100 (Li-Cor, Lincoln, NE, USA). The average area of each leaf was 620 $cm^2$.

Data on the densities of *R. indica* and *A. largoensis* were subjected to repeated measures analysis Anova GLM Repeated Measures (SAS Institute, Inc., Cary, NC, USA). Pearson's correlation was also performed between mite densities and weather factors. Data on weather was obtained with a digital thermo-hygrometer model HT-208 (Icel Manaus, Manaus, AM, Brazil) kept in the screen house.

The highest densities of *R. indica* were approximately 8,103, 8,028, and 6,029 specimens for all stages per plant, i.e., about 1.3, 1.3, and 0.9 mites per $cm^2$, in mid-June, late July, and mid-July, respectively, on plants with *A. largoensis* from La Réunion Island, without predators (control), and with *A. largoensis* from the state of Roraima (Figure 1). These maximum levels were much higher than those determined by Gondim Jr. et al. (2012), who observed less than 0.04 mite per $cm^2$ in a 5-year-old coconut plantation, when studying population dynamics under field conditions in Roraima.

Both predator populations remained practically constant, about ten mites per plant, up to 50 days after the first predator release. However, after the second predator release, on the 46th day, the La Réunion population increased, reaching a density of about 35 predators per plant (about 0.006 predator per $cm^2$) on the 72nd day, whereas the Roraima population reached a maximum of 16.8 predators per plant (about 0.002 predator per $cm^2$) on the 92nd day. However, the densities of both populations reduced drastically after the end of July, with a concurrent decrease in the prey population. None of the predator populations increased despite the second and the third releases (Figure 1).

The repeated measures analysis showed a difference between treatments only for *R. indica* egg densities (F=8.15; p=0.02). These differences are probably related to the increase in the density of eggs in late June and in July on seedlings with *A. largoensis* from La Réunion Island (Figure 1). In addition, the repeated measures analysis showed no differences between the densities of the two populations of *A. largoensis* (F=1.84; p=0.22).

Better results could have been obtained if an alternative source of food had been offered to the predator. *Amblyseius largoensis* is a generalist predator, i.e., a subtype III-b-generalist predator living

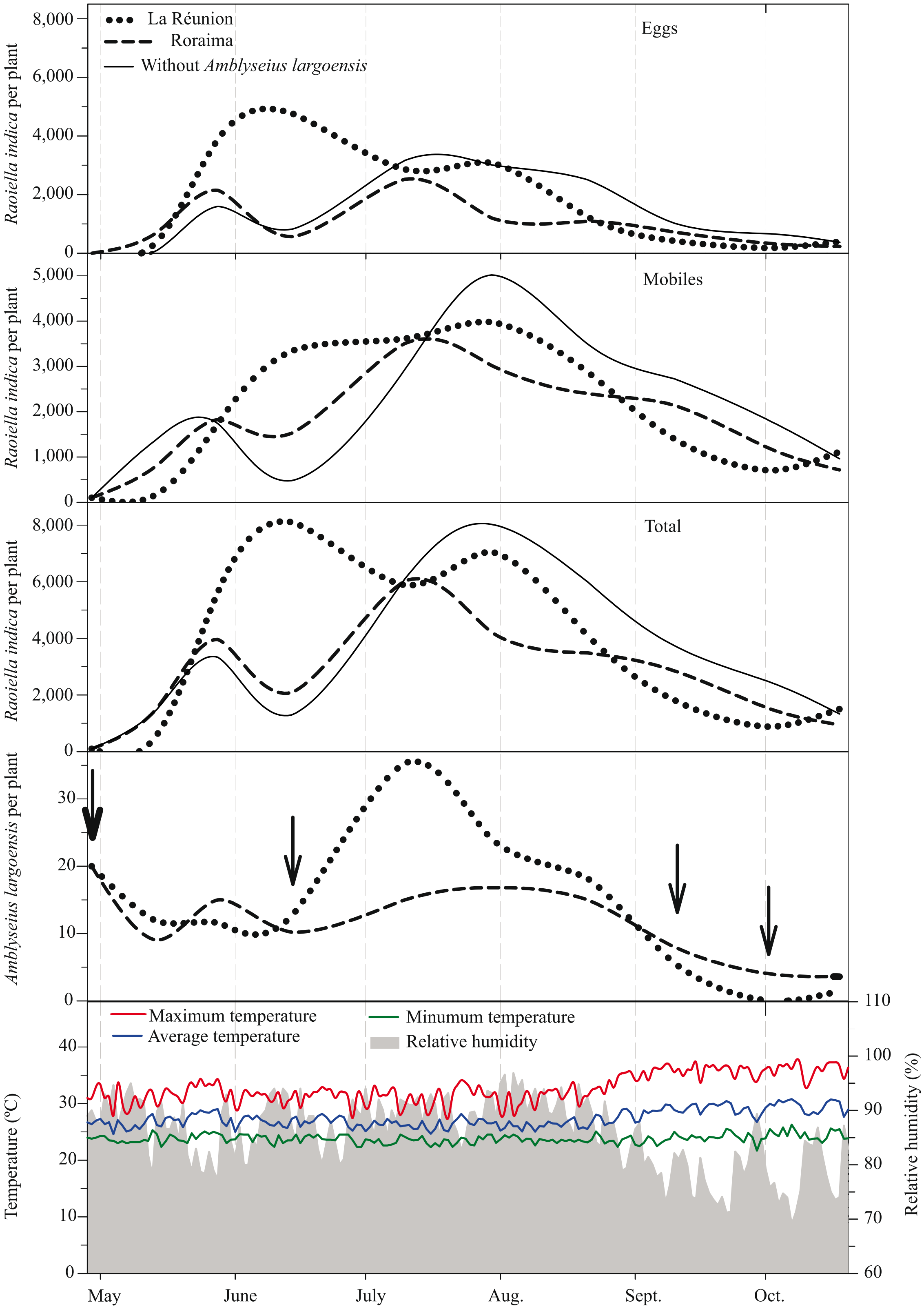

**Figure 1.** Population dynamics of *Amblyseius largoensis* and *Raoiella indica* on coconut (*Cocos nucifera*) seedlings with *A. largoensis* populations from La Réunion Island and from the state of Roraima, Brazil, and without predator release (control), as well as weather data during the experiment. The arrows indicate predator release.

on glabrous leaves, which consumes phytophagous mites, pollen, and plant exudates (McMurtry et al., 2013). Therefore, food diversification may increase the population growth of *A. largoensis* (Carrillo et al., 2010).

Furthermore, the occurrence of *A. largoensis* on coconut is reported only on fully-grown plants, but not on seedlings (Gondim Jr. et al., 2012). The architecture, the microclimate, and the low food diversity on coconut seedlings probably affect the establishment and the performance of *A. largoensis*. Carrillo et al. (2014) also reported low population densities of *A. largoensis* on coconut seedlings in glasshouse experiments. Solar radiation, especially UVB, may be lethal to predatory mites and favor the development of some phytophagous mites (Fukaya et al., 2013). In the present study, the leaf abaxial surface of the seedlings, onto which prey and predators had been released, was greatly exposed to sunlight, differently from most leaves of fully-grown plants.

No significant correlation was observed between the densities of *R. indica* and weather factors. Densities of *A. largoensis* from La Réunion Island and from the state of Roraima were negatively related with mean temperature ($R^2$ = -0.85, p=0.001; and $R^2$ = -0.86, p=0,001, respectively) and maximum temperature ($R^2$ = -0.82, p=0.004; and $R^2$ = -0.84, p=0,002, respectively), but positively related with air relative humidity ($R^2$ = 0.81, p=0,004; and $R^2$ = 0.82, p=0,004, respectively). The decrease in the level of prey and predator after the middle of the experimental period coincided with an increase in temperature and a reduction in the level of relative humidity. During the whole experimental period, inside the screen house, the maximum temperatures often surpassed 30ºC, with mean maximum of about 36ºC in the last two months (Figure 1), which could have affected predator performance.

The densities of *A. largoensis* from the state of Roraima were positively related with the densities of all developmental stages of *R. indica* ($R^2$ = 0.67; p=0.04), whereas the densities of *A. largoensis* from La Réunion Island showed a positive relationship with the densities of the post-embryonic stages of *R. indica* ($R^2$ = 0.44; p=0.03). Therefore, the predator exhibits a type II functional response curve, that is, the number of attacked prey increase up to a maximum (predator satiation) and the control efficiency reduces with increasing prey densities (Holling, 1959). This suggests that *A. largoensis* may be more efficient at low and moderate *R. indica* densities, as also reported by Carrillo & Peña (2012). The maximum prey:predator rate was 402:1 and 643:1 for *A. largoensis* from Roraima and La Réunion, respectively. Considering that each adult of *A. largoensis* from Roraima and La Réunion can consume 7.8 and 13.8 nymphs of *R. indica* per day (Domingos et al., 2012), respectively, it can be estimated that it would be necessary to have at least 100–200 predators per plant for a significant impact on the prey population in about a week. For a Florida population of *A. largoensis*, Carrillo et al. (2014) found that the best ratio to achieve control (92% in 3 months) is ten *R. indica* to one *A. largoensis*.

The present study was not able to prove whether the population of *A. largoensis* from La Réunion Island is more efficient or not than that from the state of Roraima. Complementary studies should be conducted under conditions as close as possible to those of natural fields in order to imitate the natural environment for fully-grown plants and to increase the predation rate, by, for example, providing pollen as an alternate food to predators, orientating the abaxial surface of the leaf seedling to the ground or using seedlings with leaves expanded into leaflets.

## Acknowledgements

To Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and to Empresa Brasileira de Pesquisa Agropecuária (Embrapa), for financial support.

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Received on November 30, 2014 and accepted on October 29, 2015