






Population Fluctuation of *Selenaspidus articulatus* Morgan (Hemiptera: Diaspididae) in Rubber Tree

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Abstract

Rubber tree is the main source of natural rubber in the world. Because of its economic importance, cultivation was accentuated in several regions of Brazil in the form of monoculture, thus favoring insects to establish in the crop. Among them, the West Indian red scale cochineal *Selenaspidus articulatus* stands out, responsible for injuring rubber plants due to sap sucking. This work evaluated the fluctuation of *S. articulatus* in rubber tree clones. Sampling was carried out by collecting leaves every 15 days from PB 235, RRIM 600, PR 255 and GT 1 clones during the period of March 2013 and March 2014. RRIM 600 clone showed the highest population level of *S. articulatus*, with a population peak of 14.88 insects/leaf in June. PR 255 clone had the lowest scale infestation, demonstrating this clone's possible resistance to this species. This is the first report of *S. articulatus* occurrence in Goiás.

Keywords: West Indian red scale, *Hevea brasiliensis*, seasonality.

1. INTRODUCTION AND OBJECTIVES

The rubber tree *Hevea brasiliensis* Müell. Arg. (Euphorbiaceae) is a native species to the Amazon region and stands out as being the main source of natural rubber in the world (Coelho et al., 2009; Gonçalves et al., 2002). This plant is associated with a pest complex, especially mites (Ferla & Moraes, 2008), leaf-cutting ants of the *Atta* and *Acromyrmex* genus (Anjos et al., 2008) and the lace bug *Leptopharsa heveae* Drake & Poor (Santos & Freitas, 2008). In addition to these, there are reports of other associated insects, among them termites, chrysomelids, whiteflies, cochineals, mole crickets, wood boring beetles and caterpillars (Santos & Pereira, 2008).

The first report of high *Selenaspidus articulatus* cochineal populations in rubber trees occurred in 1988 in the municipality of Olímpia, São Paulo state (Bergmann et al., 1988). Belonging to the group of scaled cochineals, they cause damage to perennial and ornamental plants (Culik et al., 2008) and are considered important pests (Henderson, 2011). The main damage is caused by continuous sap sucking from leaves, fruits

and branches. However, these insects can introduce toxins that cause leaf fall and influence fruit quality (Bartra, 1974). The genera *Pinnaspis*, *Aspidiotus* and *Saissetia* are found in the rubber tree culture (Bergmann et al., 1988; Bergmann et al., 1991). Santos & Pereira (2008) report some species associated with rubber tree, such as *Pinnaspis* sp., *Aspidiotus destructor* Signoret, *Saissetia coffeae* Walker, *Sa. oleae* Oliv., *Parasaissetia nigra* Nietner, *Asterolecanium pustulans* Cockerell and *Hemiberlesia lataniae* Signoret.

West Indian red scale *S. articulatus* has been reported in Brazil in several species of host plants in the tropical and subtropical regions, namely cherimoya (*Annona cherimola*), coconut palm (*Cocos nucifera*), passion fruit (*Passiflora edulis*), mango (*Mangifera indica*), banana (*Musa* spp.), soursop (*Annona muricata*), avocado (*Persea americana*), black pepper (*Piper nigrum*) and palm trees (Bartra, 1974). However, this species is associated with other host species, among them *Citrus limon* (Hodgson & Lagowska, 2011), *Citrus reticulata* (Rodrigues et al., 2009), *Citrus latifolia* (Vargas et al., 2015), *Coffea* spp., *Ficus* sp., *Gardenia* sp., *Pandanus* sp. (García et al., 2016),

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rubber tree (Bergmann et al., 1988) and *Mimosa caesalpiniaefolia* (Ferraz, 1997).

In recent years, an increase in the *S. articulatus* population in escape areas of the rubber tree has been observed. In some areas, the *S. articulatus* population is higher than *L. heveae*. However, no studies on this species have been carried out on rubber tree since the first report. It is necessary to verify the seasonality of this insect in several environments to contribute to integrated pest management in rubber tree plantation. In addition, it is necessary to observe if the rubber tree clones influence the population of this species. Thus, the objective of this study was to evaluate the population of West Indian red scale cochineals in rubber tree clones.

2. MATERIALS AND METHODS

The study was carried out in the commercial areas of OL Látex Ltda. (15°19'21" S and 49°9'32" W) (Figure 1) in the

municipality of Goianésia, Goiás, Brazil. The climate of the region is Aw, tropical climate with dry winter season, according to the Köppen classification, with a well-defined rainy summer season and dry winter.

Sampling was performed in areas of PB 235, RRIM 600, PR 255 and GT 1 clones. The evaluations occurred every 15 days, quantifying the amount of *S. articulatus* during the period of March 2013 and March 2014, totalizing 26 evaluations.

At each sampling, 15 trees/clones were randomly selected, and three leaves/plants were collected at a height of 7 m using pruning shears with a telescopic handle. After the collection, the leaves were packed in plastic bags and transported in an isothermal polystyrene box refrigerated with gel packs. The samples were kept in the laboratory under refrigeration at 10 °C for not more than one week until evaluation which was done using a stereoscopic microscope to observe and count the number of nymphs and adults of *S. articulatus* on the leaves (Figure 2).



Figure 1. Covoá farm rubber tree area. Goianésia, Goiás, Brazil.



Figure 2. *Selenaspidus articulatus* in a rubber tree leaf.

The relation between population density (mean of adults and nymphs/leaf) and meteorological data (maximum, minimum and mean temperature (°C), relative humidity (%), and precipitation (mm)) was assessed by linear correlation. The climatic data used were obtained from the Usina Jalles Machado S.A. meteorological station (Figure 3), located in the municipality of Goianésia, Goiás, Brazil (15°12'43" S and 48°59'13" W) 22 km from the study area.

The data obtained from the insect population during the study period are presented in the population fluctuation plot generated by the R program. The comparison between the clones was performed using the 95% confidence interval, considering that the population peak occurred between March and July. The population was compared by checking the overlap of the error bars.

3. RESULTS AND DISCUSSION

Selenaspidus articulatus was observed in greater abundance from March to July, before the natural senescence period of the leaves (Figure 4). After this period, the insect population reduced drastically; however, from December to January a gradual increase in the population was observed, limited by a decrease in February, followed by a new increase in March. The longest occurrence period of *S. articulatus* was observed in GT 1 and RRIM 600 clones, whose infestation occurred during four months from April to the second fortnight of July, and from March to June, respectively.

The natural senescence of the clones occurred in July and August. With leaf resprouting, West Indian red scale populations were higher in the months preceding natural senescence, after

the end of the rainy season. This population peak coincides with the population increase in the *C. heveae* mite, which mainly occurs from March (Demite & Feres, 2005; Hernandes & Feres, 2006; Martins et al., 2012; Vis et al., 2006). The development, reproduction and survival of *C. heveae* are favored in rubber tree between January and April (Daud et al., 2012). Therefore, it can be observed that plant phenology is a factor that contributes to the West Indian red scale population increase. According to Santos et al. (2012), the rubber tree reaches its maximum level of foliage in October, with an increase of soluble nitrogen also occurring due to a rise of precipitation which may favor the population peak of *L. heveae*.

The increase in the population of this species in PB 235 clone began at the end of April and the population peak occurred at the beginning of July. After leaf senescence in the dry period of the year, the West Indian red scale cochineal population was observed in a reduced number in all studied clones, rising again in March 2014. The second population peak of the species occurred in March in PB 235, GT 1 and PR 255 clones. In the following year, the population only remained low in the RRIM 600 clone.

The RRIM 600 clone presented the highest population level of the West Indian red scale cochineal of 14.88 individuals/leaf, followed by the GT 1 clone with a population peak of 10.26 at the end of June. At the beginning of July, the PB 235 clone had a population of eight insects/leaf. However, at the end of the same month, there was a decrease in the insect population due to natural senescence. Bergmann et al. (1988) observed a high *S. articulatus* population in March and April in the RRIM 600 clone in the state of São Paulo. The population in this study was mainly observed from April to June 2013, with a population peak in April.

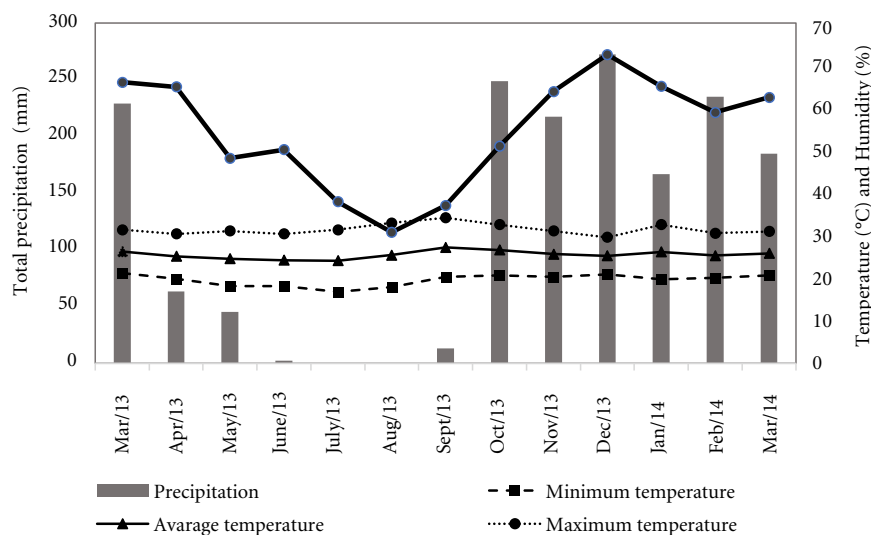


Figure 3. Climatic data (precipitation, average temperature, minimum temperature, maximum temperature and relative humidity) in the periods of 2013-2014 of Usina Jalles Machado meteorological station, Goianésia, Goiás, Brazil.

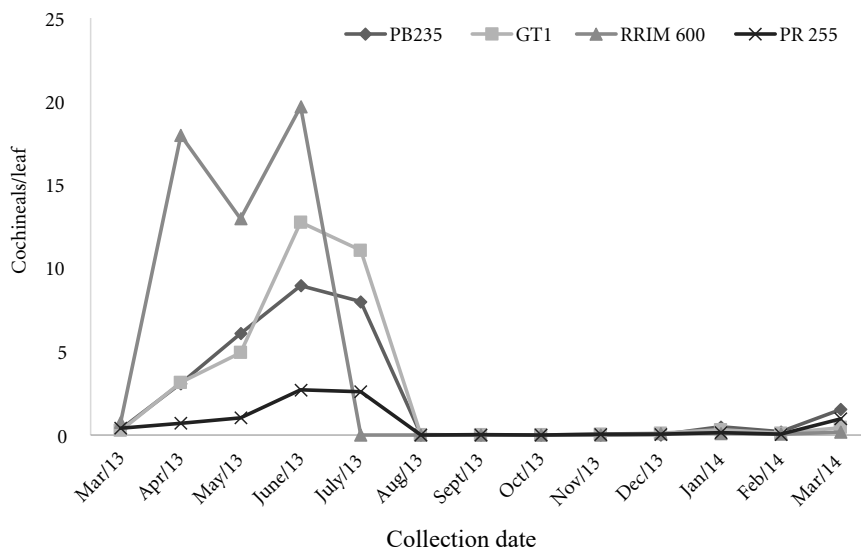


Figure 4. *Selenaspidus articulatus* population fluctuation in rubber tree clones. Goianésia, Goiás, Brazil.

PR 255 clone presented the lowest cochineal infestation throughout the study. The population began to increase in late May, and the peak population occurred in June (1.7 insects/leaf). The population was three times smaller than the other clones. The cochineal population varied among the evaluated rubber tree clones (Figure 5). PR 255 clone stood out with the lowest population, in contrast to PB 235, GT 1 and RRIM 600 clones. The smallest population in PR 255 is possibly related to the resistance of this clone to *S. articulatus*.

This result may be indicative of resistance, as Vieira et al. (2009) observed that the FRP/12110 progeny was less attacked by mites (*Calacarus heveae* and *Tenuipalpus heveae*), presenting to non-preference or antibiosis resistance. In studies carried out by Ferla & Moraes (2008), it was possible to observe that PB 260 and PR 255 clones presented larger *C. heveae* populations and leaf damage. Therefore, rubber tree clones influence the population of mites.

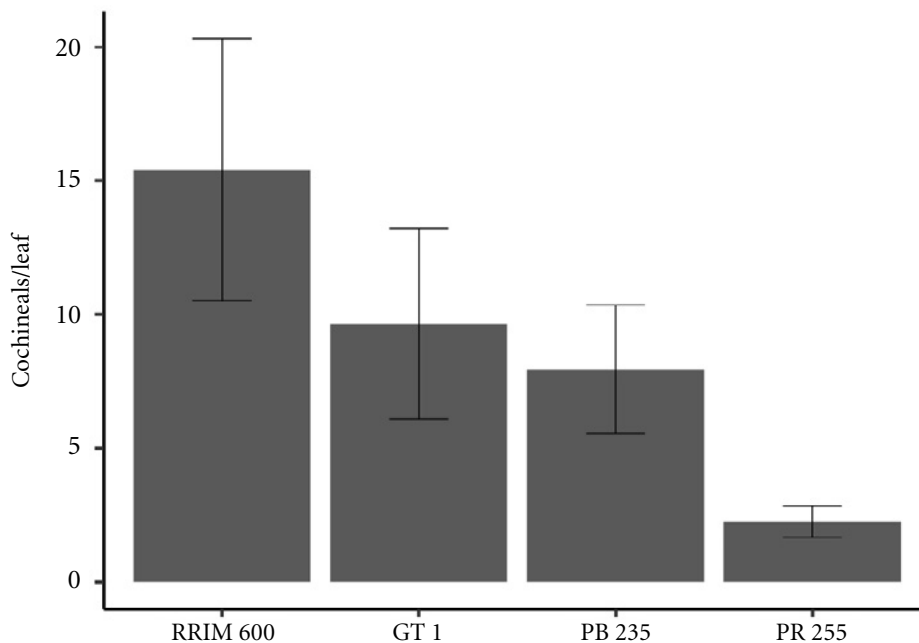


Figure 5. *Selenaspidus articulatus* (\pm 95% confidence interval) population in rubber tree clones. Goianésia, Goiás, Brazil.

This difference between the West Indian red scale populations may be correlated to the clones' resistance. However, other factors may influence this population, such as latex production, clone adaptations to soil and climate conditions (Daud et al., 2012). Daud et al. (2013) observed that rubber tree clones may influence the populations of mites. The authors observed that the PB 260 clone presented a smaller population of phytophagous species, whereas the GT 1 clone had the largest population of predators.

The different insect population densities throughout the year are directly related to the climatic conditions, the characteristics of the studied region, and possibly due to the presence of natural enemies that can act in naturally controlling this species. Coccinellids, such as *Pentilia egena* Mulsant, *Coccidophilus citricola* Brèthes, *Azya luteipes* Mulsant, *Cycloneda sanguinea* L. and *Scymnus* spp., are important natural enemies of *S. articulatus* in citrus (Rodrigues et al., 2008).

In addition to predatory insects, entomopathogenic fungi stand out, influencing the insect population mainly during periods of high temperature and humidity (Santos & Pereira, 2008). Long periods of drought may contribute to increasing the insect population due to the lack of favorable conditions for these pathogens to develop.

Perruso & Cassino (1993) observed lower *S. articulatus* infestation in *Citrus sinensis* L. between March and July when temperature and precipitation presented low rates. However, it was possible to observe that the difference in the results in the present study mainly occurs due to phenology and the leaf age in the rubber tree. Moreover, a decrease in the cochineal population in the rubber tree was observed during the rainy season.

No significant correlations were observed between *S. articulatus* infestation in clones and climatic data. In this case, the physiological conditions of the plant may have influenced the West Indian red scale cochineal population. According to Souza et al. (2015), temperature is the factor that most affects the population size of *S. oleae*. However, this climatic factor apparently did not influence the West Indian red scale cochineal population in rubber tree.

According to Bergmann et al. (1988), *S. articulatus* has higher importance in citrus cultivation, and high populations of this insect in rubber trees are related to their proximity to citrus areas. However, the site of this study only has pasture and native vegetation neighboring the rubber tree. Thus, it is believed that the population of this insect is not correlated with citriculture.

West Indian red scale is a cosmopolitan species of African origin (Miller et al., 2005), but it is the only species of *Selenaspidus* genus that came to be neotropical (Ben-Dov, 2013). The high

incidence of this and other insect species represents a potential challenge for tropical forestry and conservation (Normark et al., 2014). *S. articulatus* was introduced in Brazil and is present in the states of Amazonas, Rio Grande do Norte, Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo and Rio Grande do Sul (García et al., 2016; Martins et al., 2004). In this way, this is the first report of *S. articulatus* in the state of Goiás.

4. Conclusions

Population peaks of *S. articulatus* occurred before the natural senescence period of the rubber tree. PR 255 clone presents the smallest *S. articulatus* population. This is the first report of *S. articulatus* occurrence in Goiás state.

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