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Rainfall and Coconut Accession Explain the Composition and Abundance of the Community of Potential Auchenorrhyncha Phytoplasma Vectors in Brazil

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Abstract

Coconut plantations are attacked by the lethal yellowing (LY), which is spreading rapidly with extremely destructive effects in several countries. The disease is caused by phytoplasmas that occur in the plant phloem and are transmitted by *Haplaxius crudus* (Van Duzee) (Auchenorrhyncha: Cixiidae). Owing to their phloem-sap feeding habit, other planthopper species possibly act as vectors. Here, we aimed at assessing the seasonal variation in the Auchenorrhyncha community in six dwarf coconut accessions. Also, we assessed the relative contribution of biotic (coconut accession) and abiotic (rainfall, temperature) in explaining Auchenorrhyncha composition and abundance. The Auchenorrhyncha community was monthly evaluated for 1 yr using yellow sticky traps. Among the most abundant species, *Oecleus* sp., *Balclutha* sp., Deltocephalinae sp.2, Deltocephalinae sp.3, Cenchreini sp., *Omolicna nigripennis* Caldwell (Derbidae), and *Cedusa* sp. are potential phytoplasma vectors. The composition of the Auchenorrhyncha community differed between dwarf coconut accessions and periods, namely, in March and April (transition from dry to rainy season) and August (transition from rainy to dry season). In these months, *Oecleus* sp. was predominantly found in the accessions Cameroon Red Dwarf, Malayan Red Dwarf, and Brazilian Red Dwarf Gramame, while Cenchreini sp. and *Bolbonota* sp. were dominant in the accessions Brazilian Yellow Dwarf Gramame, Malayan Yellow Dwarf, and Brazilian Green Dwarf Jequi. We conclude that dwarf coconut host several Auchenorrhyncha species potential phytoplasma vectors. Furthermore, coconut accessions could be exploited in breeding programs aiming at prevention of LY. However, rainfall followed by accessions mostly explained the composition and abundance of the Auchenorrhyncha community.

Key words: lethal yellowing, Fulgoroidea, Cixiidae, *Oecleus* sp., Derbidae

Auchenorrhyncha are important vectors of phytoplasmas that cause diseases in crops and ornamental plants with high economic value (Oshima et al. 2013, Paradell et al. 2014). Some species of the families of Cixiidae, Delphacidae, Cicadellidae, Derbidae, and Flatidae are among the main phytoplasma transmitters and cause serious damage to plants (Gurr et al. 2016). Such Auchenorrhyncha species feed on the sap of the plant phloem potentially vectoring phytoplasmas that inhabit exclusively phloem vessels (Weintraub and Beanland 2006).

Lethal yellowing (LY) is a rapidly expanding and highly destructive disease, resulting in the rapid death of coconut and other palm trees in countries of North and Central America, the Caribbean, Africa, Asia, and Oceania, since no economically efficient control of this disease has been established (Dollet et al. 2009, Arocha-Rosete et al. 2014, Gurr et al. 2016). In Brazil, the world's fourth largest coconut fruit and largest coconut water producer (FAO 2017), no cases of LY have been registered yet.

Although *Haplaxius crudus* (Van Duzee) (Cixiidae) is the only confirmed vector of the phytoplasma of LY (Howard et al. 1983), other planthopper species, mainly cixiids, have been identified as potential transmitters of the disease (Dollet et al. 2010). It is noteworthy the need for searching other potential Auchenorrhyncha vectors due to the occurrence of LY in areas where *H. crudus* is absent (Harrison et al. 2014, Pilotti et al. 2014).

Auchenorrhyncha surveys in coconut plantations located in some northeastern and northern Brazilian states reported the presence of *Oecleus* sp. and *Melanoliarus* sp. and *H. crudus* (F.G.S., unpublished data). However, the seasonal variations in Auchenorrhyncha vector or potential phytoplasma vectors and the factors associated with this variation in coconut-producing areas have not yet been addressed.

Such knowledge is key to support contingency plans, based on the control of the insect vector, in the case LY is introduced in the country.

Environmental factors may influence the composition of Auchenorrhyncha communities by modifying their life cycles and reproductive potential (Baptistussi et al. 2011). Temperature, relative humidity, rainfall, and wind speed have been shown to influence the population dynamics of insects in several agroecosystems (Calore et al. 2013). Apart from climatic factors, dwarf accessions of coconut could also differ in their Auchenorrhyncha composition and abundance, paving the way for future research evaluating their susceptibility to LY.

Therefore, this study aimed to address the seasonal variations in the Auchenorrhyncha community, focusing on potential phytoplasma vectors, in different seasons and dwarf coconut accessions.

Material and Methods

Samplings

The Auchenorrhyncha were collected from six dwarf coconut accessions (Brazilian Green Dwarf Jequi [BGDJ], Cameroon Red Dwarf [CRD], Malayan Red Dwarf [MRD], Brazilian Red Dwarf Gramame [BRDG], Brazilian Yellow Dwarf Gramame [BYDG], and Malayan Yellow Dwarf [MYD]) of the Brazilian Germplasm Coconut Bank, which is located on the experimental field of Embrapa Tabuleiros Costeiros, in Itaporanga D'Ajuda municipality (11°06′40″S and 37°11′15″W) (Fig. 1). The coconut germplasm bank consists of 29 dwarf and giant accessions and is considered one of the most important in the Americas (COGENT 2017).

The region has a tropical rainy climate with dry summers according to Köppen's classification (Peel et al. 2007). The mean monthly precipitation and mean temperature data were measured by a meteorological station installed in the experimental field and provided by the Brazilian Center for Weather Forecasting and Climate Studies (CPTEC), respectively. The study region has a mean monthly temperature (± SE) of 33.4 ± 27.5°C and average monthly rainfall of 257.0 ± 0 mm.

The dwarf coconut accessions were grown on soil classified as Quartzarenic Neosol. The coconut trees were 13-yr old, arranged in a 7.5 × 7.5 × 7.5-m equilateral triangle, in a completely randomized block design, with 5 replications and 96 trees per block. Mechanical weeding, fertilization, irrigation, and spraying with crude cottonseed oil on the fruits to control the coconut mite *Aceria guerreronis* (Keifer) (Acari: Eriophyidae) were carried out in all the coconut accessions over the evaluation period.

Auchenorrhyncha Collection

The Auchenorrhyncha were monthly collected from March 2016 to February 2017 on yellow sticky traps (Isca, double-sided, 8.5 × 11 cm) installed in the canopy of three trees per replication, totaling 15 traps per accession. The sticky traps were collected 15 d after set up and taken to the laboratory for the removal of Auchenorrhyncha with the aid of a solvent (Tira Cola Allchem). The Auchenorrhyncha species were counted and the cixiids were separated by sex.

The Auchenorrhyncha were identified at the family and subfamily levels, based on dichotomous keys of morphological characteristics (Triplehorn and Johnson 2011, Grazia et al. 2012). Thereafter, specimens were sent to specialists for the identification of genera and species, based on specific bibliography for each taxonomic group. Specimens were deposited in the entomological collection of the University of Delaware, Department of Entomology and Ecology of Wild Animals, Newark, DE, and at the Department of Zoology of the University of Rio de Janeiro, Brazil.

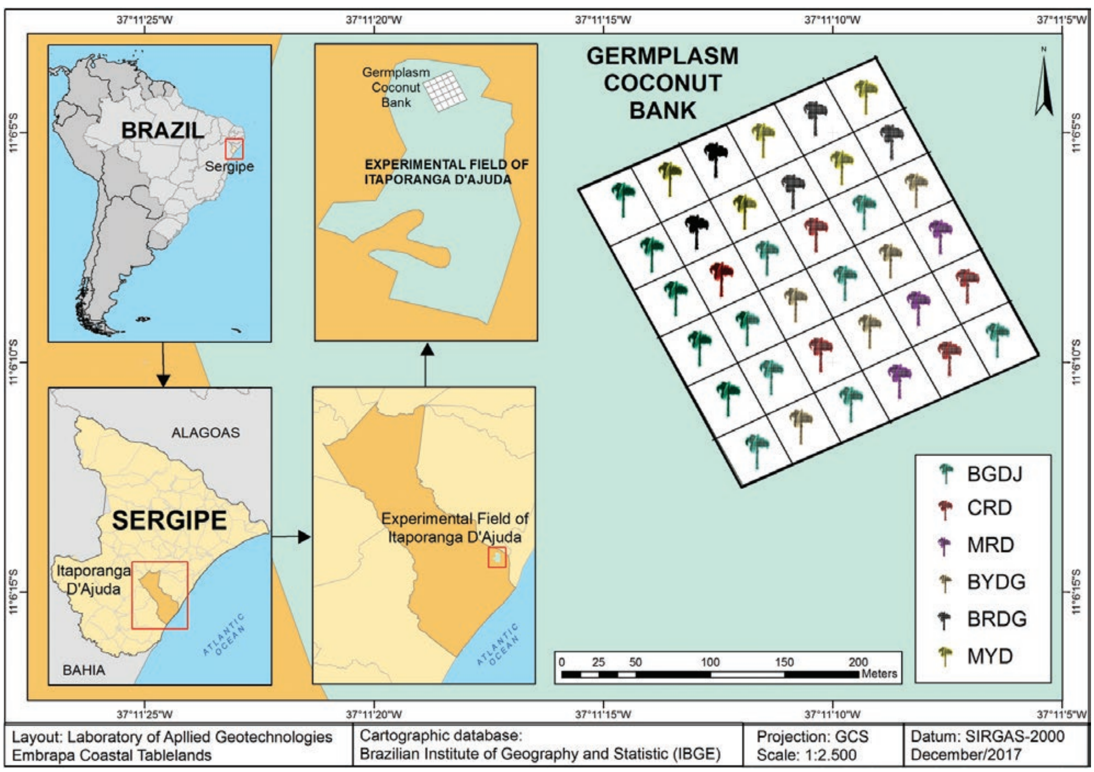

Fig. 1. Location of dwarf coconut accessions of the Brazilian Germplasm Coconut Bank.

Statistical Analysis

Changes in the composition of the Auchenorrhyncha community were modeled by the multivariate Classification and Regression Tree (CART) analysis (De'ath 2002), using total rainfall and average temperature of 1, 2, and 3 mo prior to the samplings, and the coconut accessions as explanatory variables. The CART analysis explains changes in a multivariate response variable as a function of categorical and quantitative explanatory variables (De'ath 2002). Based on all data represented by a single node at the tree top, the tree is amplified by repeated binary partitions of data of the response variable. Each partition is defined by a simple rule, based on a single explanatory variable. The explanatory variable and its respective levels or classes used in each data partition are selected from all available combinations as they result in the smallest sum of squares within the two nodes resulting from the split. The partition procedure continues until a large enough tree is obtained, which is then reduced to the appropriate size (number of end nodes). The tree size selected for interpretation ensures the smallest relative minimum error most frequently in a series of 20 cross-validations, each repeated 10 times (Breiman et al. 1984, De'ath 2002). For a new partition, the criterion selected was that each new node to be generated must be based on least three observations. The tree diagram represents all partitioning rules used to separate the different nodes. For this analysis, a library of univariate tree regression routines (T. Therneau, unpublished data) was extended by the inclusion of additional C routines for the implementation of tree-based multivariate regression (De'ath 2002). Software S-Plus (version 4.0) was used for the analyses. The count of each species was previously relativized by the sum of the counts of all species within each sample.

To characterize the typical species of each of the intermediate and terminal nodes of the CART, the indicator species analysis (Dufrêne and Legendre 1997) was used. This method calculates an indicator value (IV) for each species, which describes the degree of association of this species to a given condition. In this case, each terminal node of the CART was treated as a condition. An IV, calculated as the product of the relative abundance (RA) and the relative frequency (RF), is assigned to each evaluated species and condition. RA is expressed as the proportional abundance of a particular species, under a given condition, relative to the abundance of this same species under all evaluated conditions. The RF describes the proportion of samples under a particular condition containing a particular species. The Monte Carlo test, with 5,000 runs with randomized data, was used to test the null hypothesis that the IV obtained with the real data is not greater than that obtained randomly, i.e., that the species has no IV. For this analysis, the count data of the species were used, without relativization, using PC-ORD 6 software (McCune and Mefford 2011). The sex ratio of the cixiids was calculated from the total number of females, divided by the sum of the total number of females and males.

Results

A total of 1,063 Auchenorrhyncha were collected from the dwarf coconut accessions and almost all (>99.5%) of them belonged to four families: Cicadellidae (599 individuals), Derbidae (237 individuals), Cixiidae (184 individuals), and Membracidae (38 individuals). The rare occurrence of insects of the families Delphacidae, Flatidae, Nogodinidae, Dictyopharidae, and Cicadidae, each with one individual, was also recorded over the 1-yr evaluation period.

The Auchenorrhyncha were classified in 45 species, and most of the individuals (90%) belonged to 11 genus species: *Curtara* sp., *Oecleus* sp., Cenchreini sp., Deltocephalinae sp. 2, *Balclutha* sp., *Coelana* sp., *Cedusa* sp., *Omolicna nigripennis* Caldwell (Derbidae), *Polana* sp., *Bolbonota* sp., and Deltocephalinae sp. 3 (Table 1).

Table 1. Total number of individuals of the most abundant Auchenorrhyncha species over the evaluation period in dwarf coconut accessions in Brazil

Family	Cixiidae	Cicadellidae						Derbidae			Membracidae	
					Deltocephalinae	Deltocephalinae						
Month	*Oecleus* sp.	*Curtara* sp.	*Polana* sp.	*Balclutha* sp.	sp.2	sp.3	*Coelana* sp.	Cenchreini sp.	*Omolicna nigripennis*	*Cedusa* sp.	*Bolbonota* sp.	Total
Mar.	64	23	3	18	25	2	6	5	2	4	5	157
April	37	63	2	22	41	0	5	2	2	34	6	214
May	23	59	4	0	65	0	1	1	8	5	5	171
June	6	27	0	3	0	0	5	20	2	1	2	66
July	0	12	0	2	0	2	3	44	3	2	0	68
Aug.	3	9	0	8	0	0	2	38	4	2	0	66
Sept.	4	14	0	5	1	0	7	20	6	0	1	58
Oct.	6	3	2	7	0	0	2	14	5	0	0	39
Nov.	11	6	0	3	0	0	6	1	2	0	0	29
Dec.	3	5	1	0	0	2	6	1	0	0	1	19
Jan.	13	0	8	6	1	1	6	1	0	0	1	37
Feb.	14	0	2	4	4	5	7	0	0	0	0	36
Total	184	221	22	78	137	12	56	147	34	48	21	960

Table 2. Total number of individuals of the most abundant Auchenorrhyncha species in dwarf coconut accessions in Brazil

Family	Species	Acession						Total
		BGDJ	CRD	MRD	BRDG	BYDG	MYD	
Cixiidae	*Oecleus* sp.	23	46	64	32	9	10	184
Cicadellidae	*Curtara* sp.	77	25	22	23	39	35	221
	Polana sp.	4	3	0	1	4	10	22
	Balclutha sp.	16	19	8	23	7	5	78
	Deltocephalinae sp.2	26	11	15	29	29	27	137
	Deltocephalinae sp.3	5	5	0	0	2	0	12
	Coelana sp.	8	5	9	7	12	15	56
Derbidae	Cenchreini sp.	19	31	18	17	28	34	147
	Omolicna nigripennis	3	5	4	3	11	8	34
	Cedusa sp.	11	10	5	0	12	10	48
Membracidae	*Bolbonota* sp.	5	3	0	1	5	7	21
	Total	197	163	145	136	158	161	960

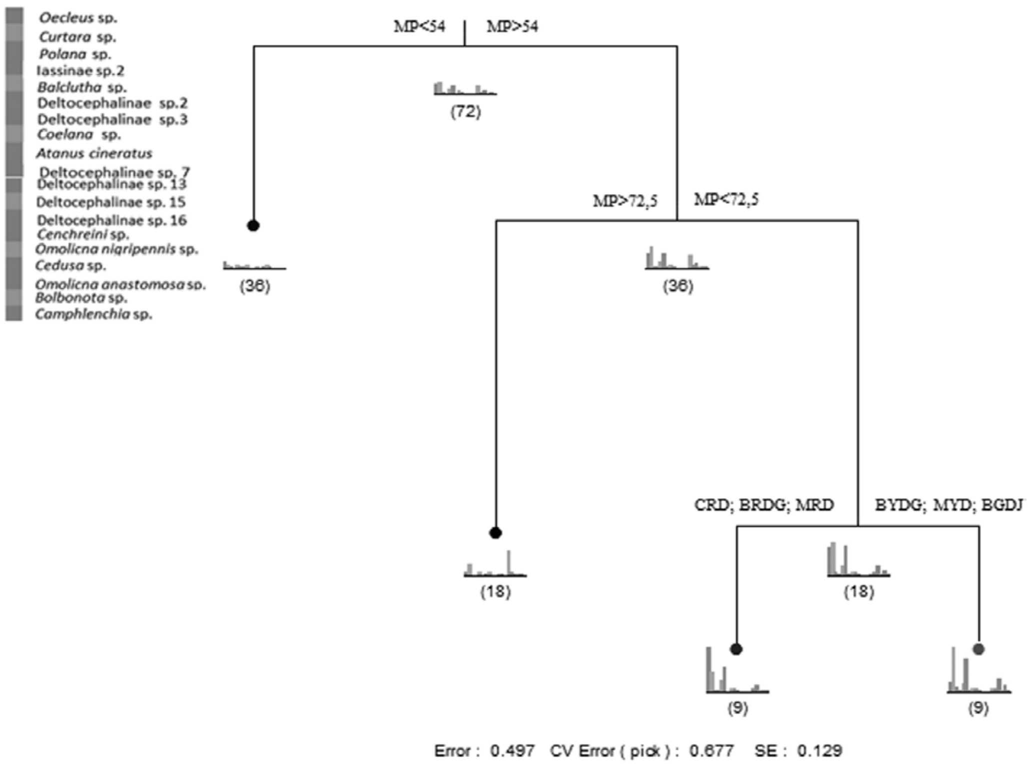

Fig. 2. Tree regression model of Auchenorrhyncha community in response to monthly precipitation and dwarf coconut accessions in Brazil. The lengths of the vertical tree branches are proportional to the variability explained by the explanatory variables used in each partition. The histograms below terminal and intermediary nodes indicate the abundance of each species in the communities represented at each node.

The Auchenorrhyncha abundance was greatest in April 2016 (precipitation 56 mm and 29°C), with 214 individuals, and lowest in December (precipitation 0 mm and 32.3°C), with only 19 individuals.The population of *Oecleus* sp., the most abundant species, reached maximum values in March (64) and April (37), with a significant population decrease from June to December, increasing again in January and February 2017. In contrast, the population of Cenchreini sp. peaked in July (44) and August (38), with marked predominance in the months immediately after the rainiest period of the year (Table 1). The highest total number most abundant Auchenorrhyncha species in the study period was found on accession BGDJ (197), followed by CRD (163), MYD (161), BYDG (158), MRD (145), and BRDG (136) (Table 2).

The selected multivariate regression and classification model consisted of a tree with four terminal nodes, which explained 51% of the data variability of the Auchenorrhyncha community composition. The rainfall in the month prior to collections and dwarf coconut accessions were selected as explanatory variables for the composition of the Auchenorrhyncha community, and the contribution to the explanation of this variability was 41 and 10%, respectively (Fig. 2).

Two distinct communities were observed between samplings preceded by a month with less rainfall than 54 mm (Group 1) or with higher rainfall than 54 mm (Group 2) (Fig. 2). The species indicator analysis for a comparison between these two groups detected that the species *Coelana* sp., *Cedusa* sp., and *Bolbonota* sp. were typical

Table 3. Indicator analysis of Auchenorrhyncha species collected on dwarf coconut trees according to the terminal nodes of the tree regression model, referring to the monthly precipitation and clustering of coconut accessions in Brazil

Comparisons between sample groups	Most abundant species	RA		RF		IV		Group with significant IV	*P*
		Group 1	Group 2	Group 1	Group 2	Group 1	Group 2		
Group 1 (MP < 54 mm) versus Group 2 (MP > 54 mm)	*Curtara* sp.	21	79	39	89	8	71	2	0.0002
	Deltocephalinae sp.2	9	91	11	47	1	43	2	0.0002
	Coelana sp.	63	37	61	31	39	11	1	0.0218
	Cenchreini sp.	26	74	31	56	8	41	2	0.0054
	Cedusa sp.	10	90	6	36	1	33	1	0.0016
	Bolbonota sp.	18	82	8	31	2	25	1	0.0172
		Group 3	Group 4	Group 3	Group 4	Group 3	Group 4		
Group 3 (MP > 7.5 mm) versus Group 4 (54 mm < MP <72.5 mm)	*Oecleus* sp.	13	87	28	94	4	82	4	0.0002
	Deltocephalinae sp. 2	0	100	0	94	0	94	4	0.0002
	Cenchreini sp.	89	11	89	22	79	2	3	0.0002
	Cedusa sp.	14	86	17	56	2	48	4	0.0054
	Bolbonota sp.	15	85	11	50	2	43	4	0.0512
		Group 5	Group 6	Group 5	Group 6	Group 5	Group 6		
Group 5 (CRD, BRDG, MRD) versus. Group 6 (BYDG, MYD, BGDJ)	*Oecleus* sp.	69	31	100	89	69	28	CRD, BRDG, MRD	0.0002
	Cenchreini sp.	0	100	0	44	0	44	BYDG, MYD, BGDJ	0.0812
	Bolbonota sp.	21	79	22	78	5	61	BYDG, MYD, BGDJ	0.0394

MP, monthly precipitation.

Table 4. Total number and sex ratio of *Oecleus* sp., captured on dwarf coconut accessions in Brazil

Accession	Males (M)	Females (F)	Total	Sex ratio (F:M)
1. BGDJ	23	1	24	0.04
2. CRD	37	8	45	0.17
3. MRD	54	10	64	0.15
4. BRDG	30	2	32	0.06
5. BYDG	8	1	9	0.11
6. MYD	10	0	10	—

of the samples of Group 1, while *Curtara* sp., Deltocephalinae sp. 2, and Cenchreini sp. represented Group 2 (Table 3). It is noteworthy that the highest IV for Group 1, attributed to *Coelana* sp. (IV = 39), was due to a RA of 63% (proportion of the total number of individuals in the samples of group 1) and to a RF of 61% (proportion of samples of Group 1 containing the species). For Group 2, *Curtara* sp. had the highest IV, of 71, resulting from a RA of 79% and RF of 89%.

No other factor was able to increase the explanation of variability in the composition of the Auchenorrhyncha community in samples preceded by months with less rainfall than 54 mm. However, two distinct communities were observed in the samples preceded by months with rainfall higher than 54 mm: one proceeded by a month with precipitation between 54 and 72.5 mm and the other with precipitation exceeding 72.5 mm (Fig. 2). Cechreini sp. was the only typical species when sampling was preceded by months with precipitation higher than 72.5 mm (Group 3). This species had an IV of 79, based on RA and RF of 89%. At an intermediate moisture level (54 mm < MP < 72.5 mm; Group 4), the best represented species were Deltocephalinae sp. 2 (IV = 94); *Oecleus* sp. (IV = 82); *Cedusa* sp. (IV = 48); and *Bolbonota* sp. (IV = 43). Individuals of Deltocephalinae sp. 2 were observed exclusively in Group 4 (RA = 100%), occurring in almost all collections of this group (RF = 94%). The RA and RF values for *Oecleus* sp. were 87% and 94%, respectively (Table 3).

In the subgroup of insects collected after months with precipitation between 54 and 72.5 mm, the red dwarf coconut accessions (MRD, BRDG, and CRD, Group 5) had Auchenorrhyncha communities with a different composition than the yellow and green accessions (BYDG, MYD, and BGDJ, Group 6). *Oecleus* sp. was the only typical species on red dwarf coconut, with IV, RA, and RF values of 69, 69, and 100%, respectively. For the yellow and green dwarfs, the best represented species were Cenchreini sp., with IV, RA and RF values of 44, 100, and 44%, respectively, and *Bolbonota* sp., with respective values of 61, 79, and 78% (Table 3).

The highest number of *Oecleus* sp. individuals was collected on MRD and CRD accessions, while the fewest planthoppers of this species were found on yellow dwarf accessions. Only *Oecleus* sp. males were found on MYD, whereas the number of females was highest on the red dwarfs (MRD and CRD) (Table 4).

Discussion

Our results indicate that the seasonal variations in Auchenorrhyncha community were mainly explained by rainfall while distinct compositions were also found on coconut dwarf. Cixiidae, Derbidae, and Cicadellidae, considered to be potential vectors of phytoplasmas, were found in our study. The high abundance of individuals of the species *Oecleus* sp., *Cedusa* sp., *Omolicna* sp., and Deltocephalinae ssp. is noteworthy, since they feed exclusively on phloem sap where phytoplasmas also occur; therefore, they are considered as potential vectors of these pathogens (Weintraub and Beanland 2006).

In the Cixiidae family, there are numerous species of phytoplasma vectors, such as *H. crudus*, the LY vector (Howard et al. 1983), and other phytoplasma-transmitting cixiids that cause diseases in grapevine, maize and Solanaceae (Bressan et al. 2009, Jovic et al. 2009, Forte et al. 2010, Maniyar et al. 2013, Cvrkovic et al. 2014, Chuche et al. 2016).

Not only the cixiids, but also several species of Derbidae, including *Proutista moesta* (Westwood) (Derbidae), which was recorded as vector of coconut root (wilt) disease in India (Rajan 2013), and

Cedusa sp. (Brown et al. 2006), *Diostrombus* spp. (Philippe et al. 2009), *Diostrombus mkurangai* Wilson (Derbidae) (Mpunami et al. 2000), and *Proustia* sp. (Pilotti et al. 2014) are considered putative vectors of phytoplasmas causing LY. The status putative vectors are attributed to species capable of harboring phytoplasmas in their body, but for which the potential for transmission of these phytopathogens has not yet been proven (Gurr et al. 2016).

Species of the subfamily Deltocephalinae, which also feed on phloem, are considered phytoplasma vectors of various agricultural crops, and more than 75% of all species confirmed as phytoplasma vectors belong to this subfamily (Weintraub and Beanland 2006). The authors also report that Delphacidae is an important family of phytopathogen vectors. These planthoppers feed mainly on pasture and are likely to occur in lower abundance in species of Arecaceae.

The composition and abundance of the Auchenorrhyncha community were mostly related to the rainfall, followed by dwarf coconut accessions. The seasonal variation of insects is influenced by interactions between biotic and abiotic environmental factors, especially in the case of sap suckers, which can be affected by temperature, changes in rainfall patterns and conditions of host plants, directly influencing their development and reproduction rates (Sehgal et al. 2006, Paradell et al. 2014).

The explanation of the variability in the Auchenorrhyncha community may be associated with the adaptation of different species to different environmental conditions. Contrasting responses to precipitation conditions were observed between Cenchreini sp., typical of the rainy season, and Deltocephalinae sp.2, *Cedusa* sp., and *Bolbonota* sp., typical of the dry season. The increasing abundance of some species is worth emphasizing, particularly of *Oecleus* sp., in the transition phase between the dry and the rainy season.

The total monthly rainfall of the month preceding collections was identified by tree regression and classification analysis as the variable with greatest explanatory potential for the variability in the composition of Auchenorrhyncha communities. This observation is in line with the mean cycle time of several Auchenorrhyncha species, from egg hatching to the final transformation into adults (Grazia et al. 2012). The increase in photosynthetic activity of the host plants during the nymphal phase due to the onset of rain is most likely also an important nutritional factor for the increase in Auchenorrhyncha populations with preference for humid periods.

H. crudus nymphs develop on roots of grasses or cyperaceae, where they find moisture, shading, and feeding, while adults feed on the palm phloem sap of coconut and palm trees (Howard et al. 1983, Arango et al. 2011). Thus, according to field observations, the presence of grasses in the vicinity of coconut plantations may have contributed to the planthoppers population increase, especially of *Oecleus* sp, a species of the same tribe (Oecleini) as *H. crudus*.

Auchenorrhyncha locate host plants guided by volatile substances, leaf color, and nutritional composition of the plants (Picanço et al. 2003, Bento et al. 2008). The marked yellow color of phytoplasmas diseased plants, depending on the variety, may make it visibly more attractive to potential insect vectors (Koji et al. 2012). However, *Oecleus* sp. was strongly predominant in red dwarf coconut accessions during this research. Thus, the higher abundance of *Oecleus* sp. on red dwarf coconut accessions is an indicator of the higher preference of these planthoppers for these accessions. Thus, the higher occurrence of this potential vector will consequently increase the possibility of transmission of LY phytoplasmas, if this phytopathogen is introduced in Brazil. On the other hand, yellow and green coconut accessions could be highlighted as of great interest for preventive genetic breeding programs as they are less inhabited by *Oecleus* sp.

The cultivars IACSP96-7569 and IACSP97-6682 of sugarcane were more tolerant to *Mahanarva fimbriolata* (Stål) (Hemiptera: Cercopidae), with lowest weight reduction of the above-ground plant biomass, while the abundance of this leafhopper on other cultivars was higher (Dinardo-Miranda et al. 2014). Similarly, maize cultivar 97TR61 was among the highest-yielding and least attacked by the leafhopper *Dalbulus maidis* (DeLong & Wolcott) (Hemiptera: Cicadellidae) (Picanço et al. 2003). Such studies contribute to understand not only aspects of the insect–plant interaction but also with a view to integrated pest management with the development of less susceptible agricultural varieties.

The number of *Oecleus* sp. males was higher than that of females in dwarf coconut accessions, which was possibly associated with the difference in weight and size of the individuals, since males are smaller and lighter than females and have greater mobility, and sexual maturity is usually achieved faster (Sujii et al. 2000). The authors also report that the sex ratio can also be altered by climatic factors, especially the differences in temperature during the egg incubation phase between one season and the other, influencing planthopper reproduction.

Here, we shown the presence of Auchenorrhyncha species that are potential phytoplasma vectors to coconut in Brazil. Knowledge about the occurrence of potential vectors and in the composition of the Auchenorrhyncha community will contribute to find methods for a contingency approach of LY, if it enters the country. Future studies may verify the transmission capacity of potential vectors, identification of host plants and the development of biological, cultura, and chemical control strategies, as well as studies of attractiveness of different coconut accessions and the identification of the related attractiveness/repellency. Also, genetic control could be developed, exploring less susceptible accessions.

Conclusions

Although the only known vector of LY, *H. crudus*, was not found in this study, other Auchenorrhyncha species with potential for phytoplasma transmission of the families Cixiidae and Derbidae and the subfamily Deltocephalinae were found on different dwarf coconut accessions.

In general, the greatest abundance of Auchenorrhyncha was recorded in BYDG accession and in the transition between the dry and rainy season. The seasonal variation and climatic conditions influence the composition and abundance of the Auchenorrhyncha community, indicating Cenchreini sp. and *Bolbonota* sp. as typical of the rainy seasons and the accessions BYDG, MYD, and BGDJ, and *Oecleus* sp. as typical of the dry to rainy season transition, on the accessions CRD, MRD, and BRDG.

The composition of the Auchenorrhyncha community on different dwarf coconut accessions differs, and this variability can be exploited in preventive breeding programs for phytoplasma-induced diseases, e.g., coconut LY, or the development of phytochemicals to monitor and control the insect vectors of this disease.

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