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Inventory of refuge plants of *Recilia mica* Kramer (Homoptera, Cicadellidae), blast disease vector in oil palm nursery (*Elaeis guineensis Jacq.)*

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ABSTRACT

Blast is the most important disease in nursery of palm tree in West Africa. The mycoplasm responsible of this disease is transmitted by the vector *Recilia mica* KRAMER (Homoptera, Cicadellidae). The aim of this study was to determine *R. mica* KRAMER plants reservoirs. To achieve this objective, an inventory of the flora frequented by this insect was carried out around two selected plots including a palm tree nursery and a plantation. In total, 14 plants were identified around the nursery and 15 plants around the plantation. Some plants have been registered in both environments. Plants considered refuges for *R. mica* in this study were *Digitaria horizontalis, Pueraria phaseoloides, Panicum maximum, Oldemlandia herbacea, Ageratum conyzoides, Ipomea eriocarpa, Eleusine indica.* Furthermore, this study showed that the *Recilia mica* frequents more plants of the Poaceae family compared to other plant families. This study should be continued to study the reproductive biology of *R. mica*

Keywords: Oil Palm tree, Blast disease, *Recilia mica*, refuge plants.

INTRODUCTION

The oil palm tree (*Elaeis guineensis* Jacq.) is cultivated in the intertropical zones of Asia, Africa and Latin America. This extremely productive plant is grown for oil palm and palm kernel oil extracted from the pulp and almond of the fruit respectively. This palm oil is now the world's leading source of fat. In West Africa, particularly in Côte d'Ivoire, oil palm cultivation occupies an important place in the country's economy. Oil palm occupies the 4th place after cocoa, coffee and cotton (Cepici, 2017) in Côte d'Ivoire. At regional level, the country is the largest oil palm producer in West African Monetary Economic Union (WAEMU) with 90% of oil production (Osseni et al., 2009; Tano et al., 2019) and it is the 2nd largest producer in Africa behind Nigeria (Tuo, 2013). Côte d'Ivoire is also the 7th largest producer in the world (Cepici, 2017). Despite its low international competitiveness, the "oil palm" sector in Côte d'Ivoire appears to be one of the credible alternatives, in terms of palm oil supply in the WAEMU market and in the Economic Community of West African States

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(ECOWAS) zone where the demand continues to grow (Robert, 2002). The productivity projection in the country is to 600,000 tonnes by 2020.

Despite these many advantages, oil palm cultivation is limited by many phytosanitary problems. We can mention among others pathologies and a large procession of pests such as *Coelaenomenodera lameensis*, *Latoia* sp, *Prosoestus* sp, *Recilia mica* etc. These pests attack the oil palm at all stages of development, from roots to leaves (Tuo, 2013). One of the most important pathologies of the palm tree in West Africa is blast disease which attacks the palm tree at the nursery stage. This disease causes wet and nauseating rot of the base of the arrow followed by a sudden desiccation of low leaves and young leaves. It has a remarkable economic impact because it can destroy an entire nursery in one or two months. As a result, it can kill more than 50% of plants in a few days (Konan et al., 2006). It is a periodic disease that usually occured between the short rainy season and the long dry season from September to December (Bachy, 1958, Renard et al., 1975). But in recent years, with climate change, the disease occurs from November to the end of January (Renard et al., 1975). Chemical control has been a long time provided by aldicarb (Temik) and Carbofuran (Carbalm) but because of their high toxicity, they have been withdrawn from the market (Ipou et al., 2015).

Since 1987, the control method against this disease is cultural control consisting of weeding in and around nurseries. However, this does not ensure the exclusive protection of plants (Diabaté et al., 2017). In order to effectively control the insect responsible for this disease, some biological knowledge are necessary. In particular, it is essential to identify alternative plants that are also used by the insect during the biological cycle.

The general objective of this study was to determine the refuge plants of *R. mica*, vector of blast disease in oil palm nursery. Specifically, this work aimed (1) at doing an inventory of the flora frequented by *R. mica*, (2) then determining the activities of the insect on these plants, and finally (3) to investigate the temporal dynamics of this insect.

MATERIALS AND METHODS

Study site

The study was conducted at the research station of the National Center for Agronomic Research (CNRA) of Mé. This station is located in the south-east of Côte d'Ivoire, in the region of Lagunes, 30 km north-east of Abidjan, on the road leading to Alépé (Figure 1). It is bordered on the east and south respectively by the Mé River and the Aghien lagoon. It is located at 5 ° 26 ' North Latitude and 3 ° 50' West Longitude (Traoré and Mangara, 2009). There are two types of reliefs: a low plateau on which stands more than half of the plots and a low background.

The forest is composed of plants such as *Turraeanthus africanus* (Leliaceae) and *Heisteria parvifolia* (Olacaceae) (Kabrah and Ballo, 2000). The primary forest has virtually disappeared, giving way to farms dominated by the oil palm tree *Elaeis guineensis* (Palmaceae) and rubber *Hevea brasiliensis* (Euphorbiaceae). The climate is of the equatorial transition type (Péné et al., 2003), characterized by a long rainy season from April to July and a short season from October to November. These are alternated by a long dry season from December to March and a short one from August to September.

Study of the flora frequented by *Recilia mica*

The inventory of plants frequented by *R. mica* was made around a nursery and a plantation of the station (CNRA) of Mé in the period from July to August 2016. Four transects of 30 meters length and 3 meters width were set up. Each transect was divided into 10 quadras of 3 m x 3 m. The floristic inventory was made inside these quadras using a biocenometer, which is a cage with an iron frame covered with a white muslin fabric. This method involves locating a plant on which individuals of *R. mica* are posed. It is suddenly caged, trapped insects are captured using a test tube (18x100 mm) separating *R. mica* individuals from individuals of other insects.

The insects caught in this way were put in jars with the same number as the one assigned to the plants. The harvested plant species were kept in newspaper and then dried at 30 °C in an oven at the CNRA La Mé. They were then sent to the National Floristic Center (CNF) of Félix Houphouët-Boigny University of Cocody for identification.

Study of *Recilia mica* activities

According to Julien et al. (2015), the feeding and egg-laying sites of *R. mica* on the plant leaves are characteristic. These authors showed that, when small punctures are observed on the leaf blade of a frequented plant; this is considered as a source of *R. mica* feed. There is reproductive activity on a plant, when eggs are seen, protected by a canvas or larvae of this insect are observed on the leaves. However, *R. mica* is said to rest on a plant, when it is seen on the plant without any discoloration and nor laying place on the leaves. The study of the activity of *R. mica* was carried out following the methodology of Julien et al. (2015). To determine the activity of *R. mica*, five (05) leaf samples from the listed plants were collected and then observed by binocular magnifying glass in the laboratory. The presence or absence of activity on a leaf is noted down respectively by 1 and 0. Also, a score of 0 to 4 was attributed to the plants according to the intensity of the activity. So we attributed:

- 4, to plants on which *R. mica* has a strong activity (feeding, reproduction, rest)
- 3, to plants on which *R. mica* has an average activity
- 2, to plants on which *R. mica* has low activity
- 1, to plants on which *R. mica* has a very low activity.
- 0, to plants on which there is no activity of *R. mica*.

Study of the temporal dynamics of *Recilia mica*

The study of population temporal dynamics of *R. mica* consisted in capturing *R. mica* individuals on the plants recorded as frequented by the insect. These captures were made at different times of the day, between 07 am-9 am in the morning, 12 am-2 pm and 4 pm-6 pm in the afternoon.

Determination of *R. mica* refuge plants

The refuge plants are plants on which insects find a shed and food in case of our study. The shelter plants of *R. mica* were determined according to the constancy of *R. mica* on plants, the intensity of activities and the daily variations of the insect on each plant species. Thus, a score (from 0 to 4) was assigned to each plant according to the parameters above. As a result, a score of:

- 4, to plants constantly or incidentally frequented by *R. mica* at all times of capture with a high activity of either reproduction and / or feeding
- 3, to plants accidentally frequented by *R. mica* during the capture periods with an average activity of either reproduction and / or feeding
- 2 to 1, to plants very accidentally frequented by *R. mica* during at least one capture period with a low activity of reproduction and / or feeding
- 0, to plants on which there is no individual of *R. mica*.

At the end of these assigned scores, plants with an average score of 3 or more cases were considered *R. mica* shelters.

Data analysis

Data obtained in this study were processed by analysis of variance using the Statistica 7.1 software. The comparison of the averages was made by the Kruskal-Wallis test. For this purpose, the Shapiro-Wilk test was applied beforehand to check the normality of all the variables measured. Also, the software EstimateS 7.5.0 was used to estimate the specific richness of the plants visited by *R. mica*, through the non-parametric estimator Chao 2.

The relative abundance of insects was calculated using the following formula*: $di = ni/s$* where *ni* is the number of individuals of species *i* and *s* the total number of individuals.

The constancy (C) of the plant species was calculated according to the following general formula: F (%) = (Qi / Q) * 100. Where Qi: number of records of the species considered; Q: total number of quadra in the transect. According to Bigot et Bodot (1973), four categories of species are distinguished according to their constancy. In the context of our study, it is more a question of the constancy of their frequentation by *R. mica*. So we will distinguish plants:

- constantly frequented species: these are species on which *R. mica* individuals are found in 50% or more of cases;
- the species secondarily frequented (25 to 49% of cases);
- accidentally frequented species are those whose frequency is less than 25%.
- the species very accidentally frequented by *R. mica* are described as sporadic and have a frequency lower than 10%.

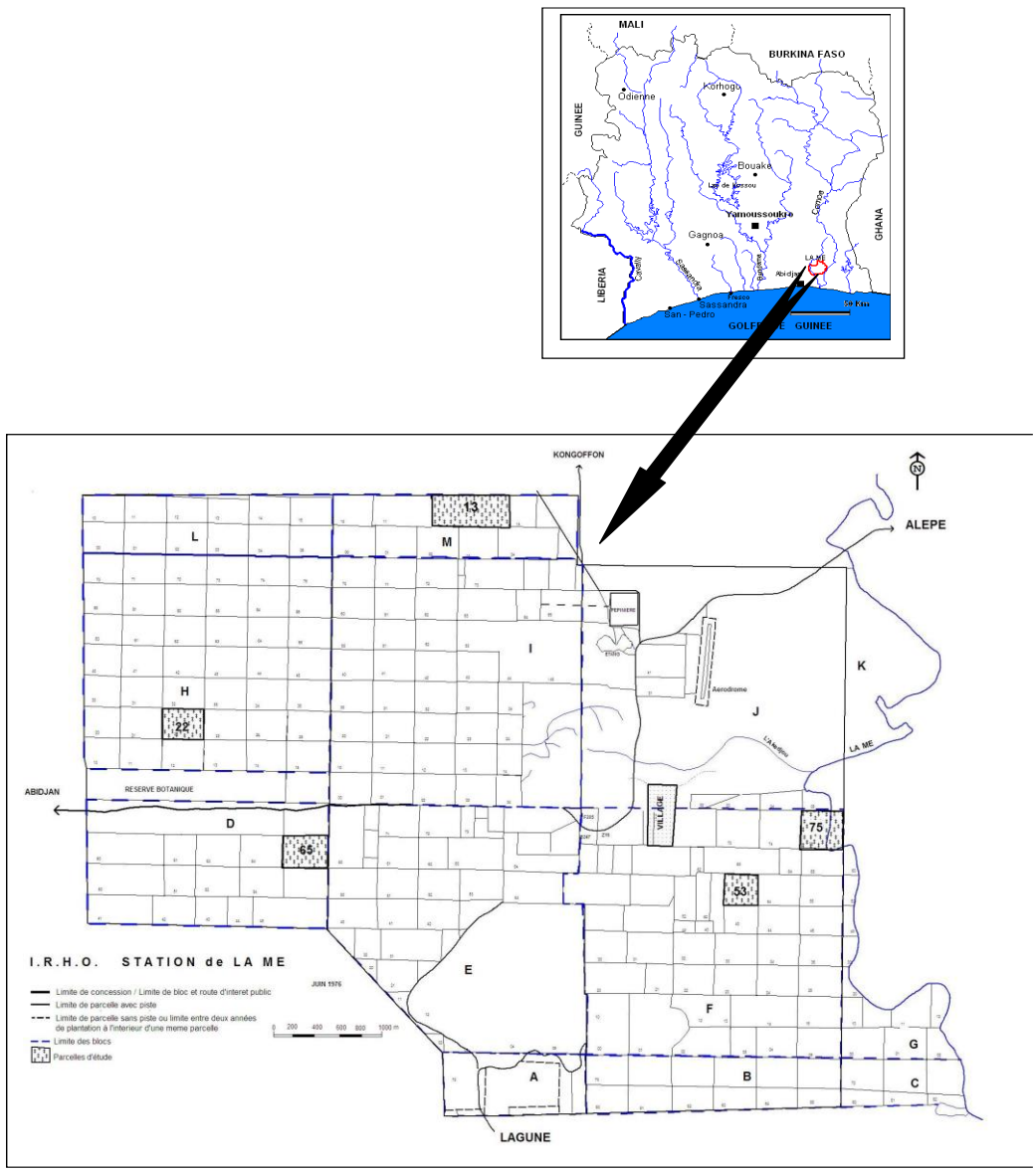

Figure 1: Location of study area.

RESULTS

Inventory of the flora frequented by *R. mica*

The results of the flora survey of *Recilia mica* revealed 14 plant species belonging to 9 families around the nursery and 15 species belonging to 12 families around the plantation (Table 1). The species richness observed in the area is respectively 14 for the nursery and 15 for planting and that expected is 14 and 16.62 respectively. The coverage rate for sampling is 100 % for the nursery (Figure 2) and 90.25% for planting (Figure 3). The study of the occurrence frequency of plants shows 7 plants incidentally frequented by *R. mica* around nursery and 3 plants around plantation, 6 accidentally plants around the nursery and a single plant around plantation, a very accidental plant around nursery and 11 plants around plantation (Tables 1 and 2).

In addition, the relative abundance of *Recilia mica* on plants around the plots was 16.42%, 14.96% and 11.68% respectively for *Digitaria horizontalis*, *Pueraria phaseoloides* and *Panicum maximum* for the nursery which were the most abundant. However, around the plantation, it is *Digitaria horizontalis* (17.07%), *Cynodon dactylon* (13.41%), *Sporobolus pyramidalis* (10.98%) which shelter more individuals of this insect (Table 2).

The results of the variance analysis with regard to the number of *R. mica* showed significant differences ($p = 0.033 < 0.05$) between the different families of plants around the nursery. For this purpose, two distinct classes A and B have been obtained. Class A containing the Poaceae family which contains the largest number of *R. mica* and class B consisting of other families around the nursery. These families harbor few individuals of this insect (Figure 4). However, around the plantation, no significant difference ($p = 0.779 > 0.05$) was observed between these different families of plants (Figure 5). *R. mica* has no plant preference in this medium.

Recilia mica activities around the nursery and plantation

The study of *R. mica* activity has distinguished three (03) main activities of this insect (Table 3). These are feeding, breeding and resting activities. For feeding activity, Table 3 indicates that *R. mica* feeds on eight (08) plants around the nursery and five (05) plants around the plantation. *R. mica* feeds on more plants around the nursery than around the plantation. The insect is said to rest on six (06) plants around the nursery and ten (10) plants around the plantation. No reproductive activity was observed on the plants in both media during the study (Table 3). However, the feeding activity is strong on the plants *Digitaria horizontalis*, *Pueraria phaseoloides* and *Eleusine indica* around the nursery. It is average on *Ipomoea eriocarpa*, *Oldenlandia herbacea*, *Ageratum conyzoides* and *Panicum maximum* than on other plants. In the vicinity of the plantation, this activity is important on the plants *Digitaria horizontalis*, *Cynodon dactylon* and *Sporobolus pyramidalis.* In addition, the feeding activity is average on *Oldenlandia herbacea* than on other plants. Rest is more important on the *Borreria latifolia* plant, *Ludwigia hyssopifolia*, *Cyperus esculentus* and *Cleome ciliata* around the nursery and on *Cyathula prostrata* and *Secamone afzelii* around the plantation (Table 3).

Temporal dynamics of *Recilia mica* around plots

The analysis of variance showed significant differences ($P = 0.002$, $P = 0.001$ and $P = 0.01$) and ($P = 0.0002$, $P = 0.001$ and $P = 0.01$) between plants as according the number of *R. mica* around the nursery and the plantation respectively at the capture periods (7 am-9 am, 12 am-2 pm and 4 pm-6 pm). Indeed, from 7 am to 9 am, *R. mica* was captured in large numbers on *Digitaria horizontalis*, *Pueraria phaseoloides*, *Panicum maximum* with an average number of 11.25, 11 and 10 individuals / plant. It was also caught in high numbers from 4 pm to 6 pm on *Digitaria horizontalis* (14 ind./plant), *Pueraria*

phaseoloides (13 ind./ plant), *Panicum maximum* (12.25 ind./plant). However, *R. mica* was more captured during the 4 pm-6 pm period on these plants than on other plants at different capture periods. However, in the 12 am to 2 pm period, *R. mica* individuals were very rarely seen on plants around the nursery (Table 4). In the vicinity of the plantation, it is rather the plants *Digitaria horizontalis* with an average number of *R. mica* 11.25 individuals, *Sporobolus pyramidalis* (11 ind./plant), *Cynodon dactylon* (10 ind./plant) and *Oldenlandia herbacea* (10 ind. / plant) which hosted a high number of *R. mica* during the period 7 am to 9 am (Table 4). From 4 pm to 6 pm, *R. mica* was more captured on the plants *Cynodon dactylon, Sporobolus pyramidalis, Digitaria horizontalis* and *Oldenlandia herbacea* with an average number of *R. mica* (12.25, 11.25, 10.75 and 10 individuals on average respectively) than on the other plants. On the other hand during the period 12 am-2 pm, very little *R. mica* was captured on the plants.

R. mica refuge plants

R. mica visits a range of plant species around selected plots (nursery and plantation). However, only the plants most frequented by these insects with intense daily activity are considered as refuge. These are *Digitaria horizontalis*, *Pueraria phaseoloides*, *Panicum maximum*, *Oldenlandia herbacea*, *Ageratum conyzoides*, *Ipomea eriocarpa*, *Eleusine indica*, *Cynodon dactylon*, *Sporobolus pyramidalis* (Table 5).

Table 1: List of plants surveyed around the nursery.

			Frequency (%) of plant species along transect (T)						
Localisation of plant species	**Plant species**	**Plant families**	**T_1**	**T_2**	**T_3**	**T_4**	**Mean of frequency (%)**	**Constancy of plants**	**Abundance of *R. mica* (%)**
Around nursery	*Ludwigia hyssopifolia*	Onagraceae	30	20	20	20	22.5	Incidental	5.11
	Borreria latifolia	Rubiaceae	20	20	20	20	20	Incidental	6.20
	Oldenlandia herbacea		40	30	30	30	32.5	secondarily	8.39
	Commelina benghalensis	Commelinaceae	30	30	0	30	22.5	Incicdental	3.65
	Bidens pilosa	Astereceae	20	20	0	0	10	Incidental	1.82
	Ageratum conyzoides		40	40	0	30	27.5	secondarily	8.03
	Chromolaena odorata		0	0	0	10	2.5	Very incidental	1.82
	Ipomoea eriocarpa	Convolvulaceae	40	40	0	20	25	secondarily	6.93
	Eleusine indica	Poaceae	70	70	0	0	25	secondarily	5.11
	Digitaria horizontalis		80	80	0	0	40	secondarily	16.42
	Panicum maximum		60	0	50	20	32.5	secondarily	11.68
	Pueraria phaseoloides	Fabaceae	60	50	0	50	40	secondarily	14.96
	Cyperus esculentus	Cyperaceae	0	20	0	30	12.5	Incidental	4.74
	Cleome ciliata	Cappadariaceae	0	30	30	0	15	Incidental	5.11

T: Transect

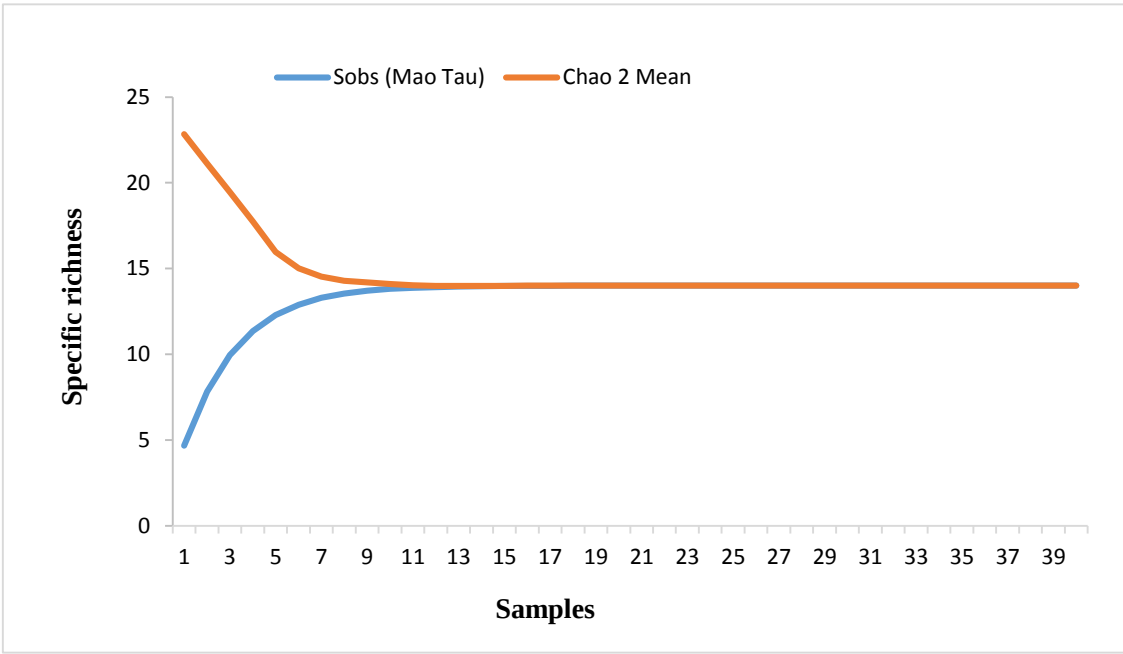

Figure 2: Specific richness in the nursery.

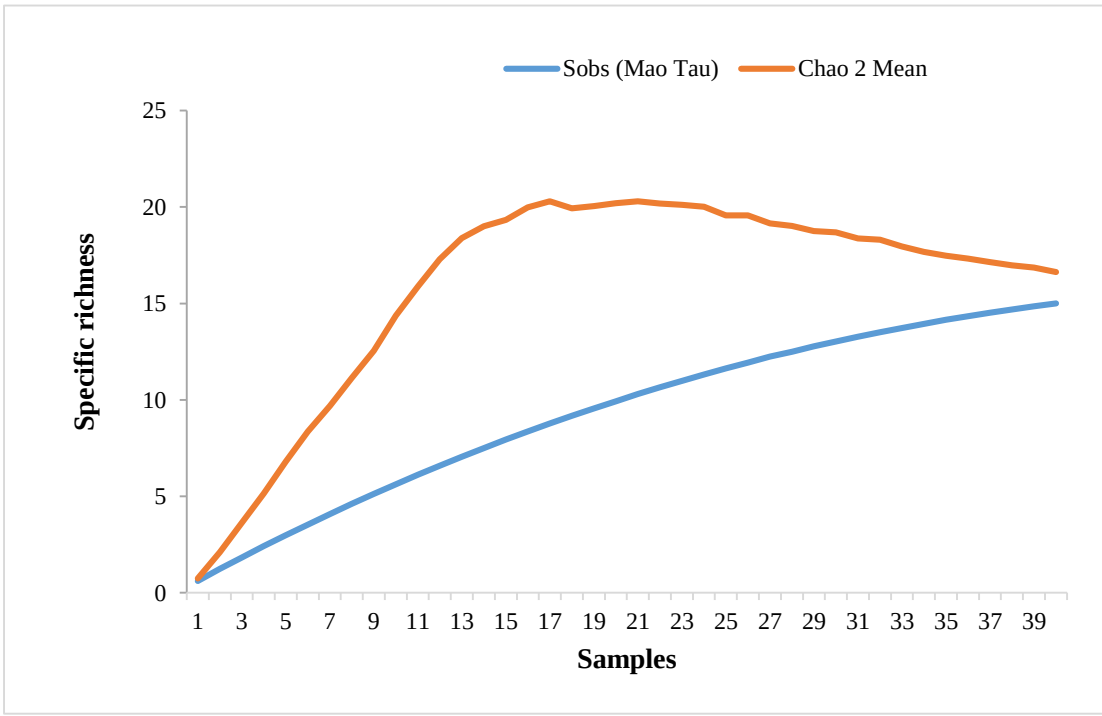

Figure 3: Specific richness in the plantation.

Table 2: List of plants surveyed around plantation.

Localisation of plant species	Plant species	Plant families	Frequency (%) of plant species by transect (T)				Mean of frequencies (%)	Constancy of plants	Abundance of *R. mica* (%)
			T_1	T_2	T_3	T_4			
Around plantation	*Mimosa piduca*	Mimosaceae	20	20	0	0	10	Incidental	6.10
	Oldenlandia herbacea	Rubiaceae	0	0	0	10	2.5	Very incidental	3.66
	Ipomea eriocarpa	Convolvulaceae	30	0	0	0	7.5	Very incidental	4.88
	Croton hirtus	Euphorbiaceae	20	0	0	0	5	Very incidental	4.88
	Centrosema pubescens	Fabaceae	30	0	0	0	7.5	Very incidental	3.66
	Pueraria phaseoloides		0	0	0	10	2.5	Very incidental	4.88
	Aspilia africana	Astereceae	10	0	0	0	2.5	Very incidental	3.66
	Cyathula prostrata	Amaranthaceae	10	0	0	0	2.5	Very incidental	8.54
	Triumfetta rhomboidea	Tiliaceae	10	0	0	0	2.5	Very incidental	3.66
	Secamone afzelii	Asclepiadaceae	0	0	20	0	5	Very incidental	7.32
	Sporobolus pyramidalis	Poaceae	10	60	30	10	27.5	secondary importance	10.98
	Digitaria horizontalis		40	50	0	30	30	secondary importance	17.07
	Cynodon dactylon		50	50	0	0	25	secondary importance	13.41
	Cyperus esculentus	Cyperaceae	0	0	0	10	2.5	Very incidental	4.88
	Sida acuta	Malvaceae	0	0	0	10	2.5	Very incidental	2.44

T: Transect

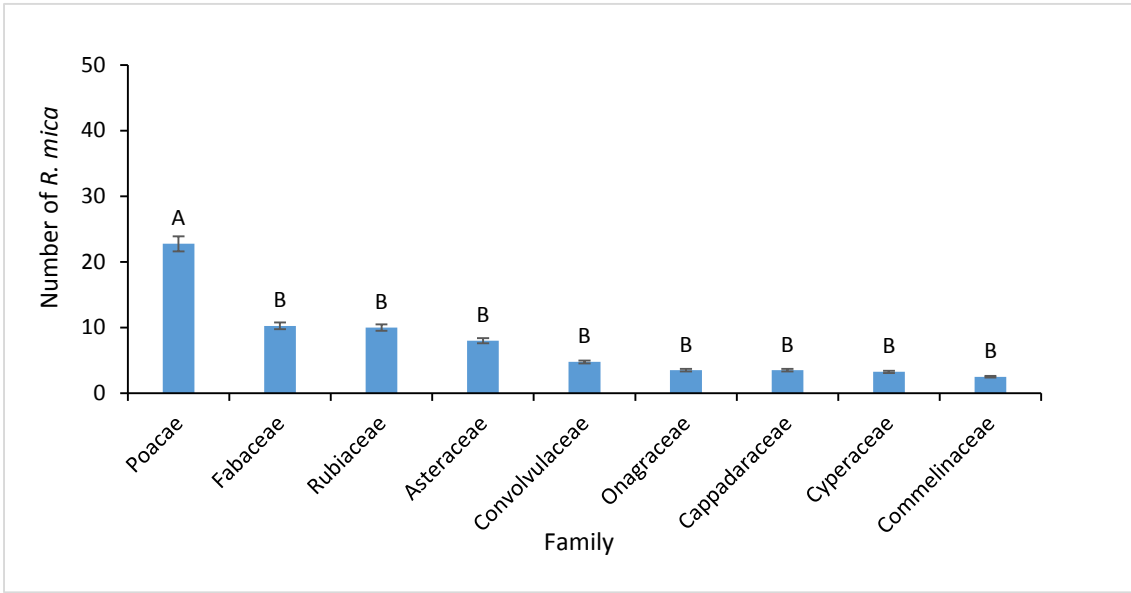

Figure 4: Comparison diagram of plant families according to the number of *R. mica* around the nursery.

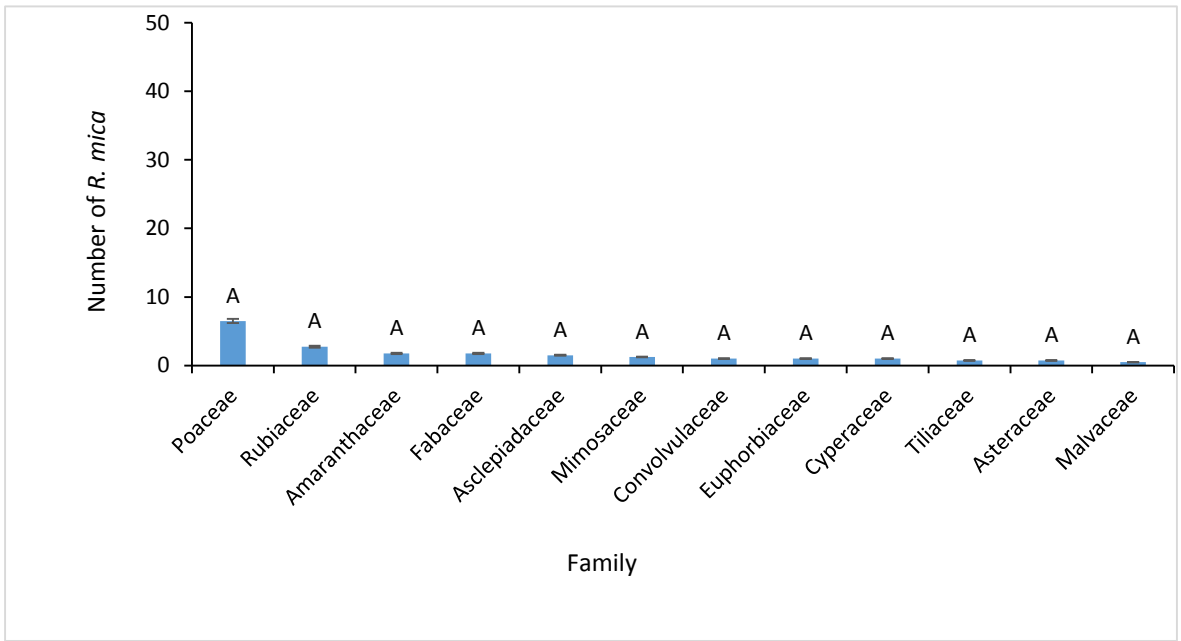

Figure 5: Comparison diagram of plant families according to the number of *R. mica* around the plantation.

Table 3: List of plants and score of *R. mica* activities around the parcels.

	Score of *R. mica* activities														
	Feeding					Rest					Reproduction				
	T1	T2	T3	T4	Mean feeding	T1	T2	T3	T4	Mean rest	T1	T2	T3	T4	Mean reproduction
Plant species around nursery															
Ludwigia hyssopifolia	0	0	0	0	0	4	4	4	4	4	0	0	0	0	0
Borreria latifolia	0	0	0	0	0	4	4	4	4	4	0	0	0	0	0
Oldenlandia herbacea	1	2	2	3	2	0	0	0	0	0	0	0	0	0	0
Commelina benghalensis	2	2	3	1	2	0	0	0	0	0	0	0	0	0	0
Bidens pilosa	0	0	0	0	0	3	2	1	2	2	0	0	0	0	0
Ageratum conyzoides	4	2	3	3	3	0	0	0	0	0	0	0	0	0	0
Chromolaena odorata	0	0	0	0	0	3	2	2	1	2	0	0	0	0	0
Ipomoea eriocarpa	3	2	3	4	3	0	0	0	0	0	0	0	0	0	0
Eleusine indica	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0
Digitaria horizontalis	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0
Panicum maximum	3	2	4	3	3	0	0	0	0	0	0	0	0	0	0
Pueraria phaseoloides	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0
Cyperus esculentus	0	0	0	0	0	4	4	4	4	4	0	0	0	0	0
Cleome ciliata	0	0	0	0	0	2	4	3	1	3	0	0	0	0	0
Plant species around plantation															
Mimosa piduca	0	0	0	0	0	4	3	2	3	3	0	0	0	0	0
Oldenlandia herbacea	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0
Ipomea eriocarpa	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0
Croton hurtis	0	0	0	0	3	1	3	1	3	0	0	0	0	0	0
Centrosema pubescens	0	0	0	0	0	2	3	2	1	2	0	0	0	0	0
Pueraria phaseoloides	3	1	3	1	2	0	0	0	0	0	0	0	0	0	0
Aspilia africana	0	0	0	0	0	3	1	2	1	2	0	0	0	0	0
Cyathula prostrata	0	0	0	0	0	4	4	4	4	4	0	0	0	0	0
Triumfetta rhomboidea	0	0	0	0	0	1	2	2	3	2	0	0	0	0	0
Secamone afzelii	0	0	0	0	0	4	4	4	4	4	0	0	0	0	0
Sporobolus pyramidalis	2	3	4	3	3	0	0	0	0	0	0	0	0	0	0
Digitaria horizontalis	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0
Cynodon dactylon	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0
Cyperus esculentus	0	0	0	0	0	3	4	3	2	3	0	0	0	0	0
Sida acuta	0	0	0	0	0	0	1	2	1	1	0	0	0	0	0

T: Transect

Table 4: Temporal dynamics of *R. mica* on plant species according to the capture hours.

		Average number of *R. mica* on the hours		
Localisation of plant species	**Plant species**	**7am-9am**	**12am-2 pm**	**4 pm-6 pm**
Around nursery	*Digitaria horizontalis*	11.25 ± 4.717 [a]	2.75 ± 2.623 [bc]	14 ± 4.966 [a]
	Pueraria phaseoloides	11 ± 2.943 [a]	5.50 ± 1.291 [a]	13 ± 7.393 [a]
	Panicum maximum	10 ± 1.825 [a]	3.75 ± 1.707 [ab]	12.25 ± 3.304 [a]
	Borreria latifolia	5.5 ± 2.645 [b]	00 ± 00 [d]	2 ± 4 [b]
	Chromolaena odorata	5.25 ± 3.775 [b]	00 ± 00 [d]	1.25 ± 2.50 [b]
	Eleusine indica	4.75 ± 3.403 [b]	3.75 ± 1.707 [ab]	6.5 ± 4.509 [b]
	Ipomoea eriocarpa	4.25 ± 3.201 [b]	00 ± 00 [d]	4.5 ± 3.316 [b]
	Cleome ciliata	3.5 ± 4.725 [b]	00 ± 00 [d]	3.5 ± 4.726 [b]
	Cyperus esculentus	3.25 ± 3.775 [b]	00 ± 00 [d]	3.25 ± 3.775 [b]
	Commelina benghalensis	3 ± 0.816 [b]	00 ± 00 [d]	3.5 ± 3.316 [b]
	Ageratum conyzoides	2.5 ± 1.732 [b]	00 ± 00 [d]	5.5 ± 4.203 [b]
	Bidens pilosa	1.25 ± 1.50 [b]	00 ± 00 [d]	1.25 ± 1.50 [c]
	Oldenlandia herbacea	1.25 ± 1.50 [b]	00 ± 00 [d]	5.75 ± 2.50 [b]
	Ludwigia hyssopifolia	1.25 ± 2.50 [b]	00 ± 00 [d]	3.5 ± 1.291 [b]
	Probability and signification	**P= 0.002<0.05**	**P= 0.001<0.05**	**P = 0.01<0.05**
Plant species around plantation	*Digitaria horizontalis*	11.25 ± 4.573 [a]	7.50 ± 1.291[a]	12.25 ± 8.015 [a]
	Sporobolus pyramidalis	11.00 ± 2.160 [a]	4.573 ± 3.250 [b]	11.75 ± 2.50 [a]
	Cynodon dactylon	10.00 ± 3.915 [a]	2.250 ± 3.00 [cb]	10.75 ± 9.810 [ab]
	Oldenlandia herbacea	10.00 ± 1.633 [a]	3.50 ± 1.291[b]	10.25 ± 4.573 [ab]
	Cyperus esculentus	5.00 ± 2.160 [b]	1.50 ± 3.00[cd]	1.50 ± 3.00 [c]
	Pueraria phaseoloides	4.75 ± 3.095 [b]	2.25 ± 0.50 [cb]	1.750 ± 2.061 [c]
	Sida acuta	3.25 ± 3.775 [b]	00 ± 00 [d]	1.25 ± 1.50 [c]
	Triumfetta rhomboidea	3.00 ± 2.449 [b]	0.750 ± 1.50 [cd]	1.50 ± 3.00 [c]
	Aspilia africana	3.25 ± 3.775 [b]	1.00 ± 1.414 [cd]	5.50 ± 1.00 [bc]
	Mimosa piduca	1.25 ± 1.500 [b]	00 ± 00 [d]	2.250 ± 1.50 [c]
	Ipomea eriocarpa	1.00 ± 2.00 [b]	00 ± 00 [d]	3.00 ± 0.001 [c]
	Croton hurtis	1.00 ± 2.00 [b]	00 ± 00 [d]	00 ± 00 [c]
	Secamone afzelii	1.00 ± 2.00 [b]	0.750 ± 1.50 [cd]	2.25 ± 2.630 [c]
	Centrosoma puldescens	0.75 ± 1.50 [b]	0.50 ± 1 [cd]	4.25 ± 1.50 [c]
	Cyathula prostrata	0.75 ± 1.50 [b]	00 ± 00 [d]	0.75 ± 1.50 [c]
	Probability and signification	**P= 0.0002< 0.05**	**P= 0.001<0.05**	**P = 0.01<0.05**

Table 5: Determination of *R. mica* refuge plants according to the specific objectives.

		Score of *R. mica* reservoir plants			
Localisation of plant species	**Plant species**	**Constancy score (OS 1)**	**Activities score (OS 2)**	**Temporal dynamic score (OS 3)**	**Average of score**
Around nursery	*Digitaria horizontalis*	4	4	4	4
	Pueraria phaseoloides	4	4	4	4
	Panicum maximum	4	3	4	3.66
	Borreria latifolia	3	0	1	1.33
	Chromolaena odorata	2	0	3	1.66
	Eleusine indica	4	4	4	4
	Ipomoea eriocarpa	4	3	3	3.33
	Cleome ciliata	3	0	2	1.66
	Cyperus esculentus	3	0	3	2
	Commelina benghalensis	3	2	2	2.33
	Ageratum conyzoides	4	3	2	3
	Bidens pilosa	2	0	1	1
	Oldenlandia herbacea	4	2	2	2.66
	Ludwigia hyssopifolia	3	0	1	1.33
Around plantation	*Digitaria horizontalis*	4	4	4	4
	Sporobolus pyramidalis	4	3	4	3.66
	Cynodon dactylon	4	4	4	4
	Oldenlandia herbacea	2	4	3	3
	Cyperus esculentus	2	0	3	1.66
	Pueraria phaseoloides	2	2	3	2.33
	Sida acuta	2	0	2	1.33
	Triumfetta rhomboidea	2	0	2	1.33
	Aspilia africana	2	0	2	1.33
	Mimosa piduca	2	0	1	1
	Ipomea eriocarpa	2	2	1	1.66
	Croton hurtis	2	0	1	1
	Secamone afzelii	2	0	2	1.33
	Centrosoma puldescens	2	0	1	1
	Cyathula prostrata	2	0	1	1

OS: Specific objectives

DISCUSSION

The plant inventory conducted around the nursery and plantation indicates that *Recilia mica* populations, vector of the blast disease in the oil palm tree nursery frequent a range of plant species belonging to various families. Indeed, like all polyphagous insects, *R. mica* is an insect that visits several hosts belonging to different families. In our study, plants like *Digitaria horizontalis, Pueraria phaseoloides, Panicum maximum, Oldenlandia herbacea, Ageratum conyzoides, Ipomea eriocarpa, Eleusine indica* serve as refuge plants for *R. mica* populations.

Therefore, there is an interaction between *Recilia mica* and these host plants based on foraging, and / or laying support or shelter for this insect. Saguez et al. (2014) testify that Leafhoppers in general feed on several plant species that serve as hosts. It is therefore likely that these plants provide the nutrients necessary for the development of this species. Also, according to Marion (2014), insects use different dietary strategies to obtain the nutrients necessary for their development. However, when taking food, they cause damage to the plant species they visit. This is the case of leafhopper species of the genus *Erythroneura* which, when feeding, causes direct damage by the depigmentation of the leaves by the injection of chloroplasts and chlorophyll into the leaf cell of grape varieties (Saguez et al., 2015). The larvae and adults of *Jacobiella facialis* Jacobi sting also the secondary leaf veins and introduce toxic saliva that causes discoloration of the leaf blade. The punctures cause yellowing of the leaf margins, leading to cessation of plant development or loss of reproductive organs (Imam et al., 2010; Koné et al., 2017). Leafhoppers can also cause indirect damage that can be seen by transmitting phytoplasma diseases to plant species. This is the case of the blast disease transmitted by the *R. mica* leafhopper to the seedlings of the oil palm, the Black Wood transmitted by *Hyalesthes obsoletus* (Hemiptera, Cixiidae) the Flavescence Dorée transmitted by *Scaphoideus titanus* (Hemiptera, Cicadellidae) to the vines (Constable, 2010).

The study of the abundance of *R. mica* according to the families of the plants has shown that this insect frequents more plant species of the Poaceae family than the other families of plants collected around the nursery. This family of plants would produce a succulent sap that would provide probably many nutrients for the development of these insects. She also seems to provide shelter against her natural enemies. This result corroborates those of Mariau et al. (1981) indicate that *R. mica* occurs on several grass species (Poaceae). In contrast, around the plantation, no significant difference was observed. This insect has no plant preference. They visit plants in the same way. This result is in line with those of Beanland et al. (2006) which states that several species of leafhoppers occur on weeds at the edges of crops.

The study of the temporal dynamics of *R. mica* indicates that this insect was captured in abundance between 07 am-09 am and 4 pm-6 pm. These hours would be the least hot of the day, the insect is less active and easier to capture. This could explain the catch in large numbers at these times. These results are consistent with those of De Franqueville et al. (1991) who, in order to maximize the chances of capturing a high number of *R. mica* in a study on the oil palm blast, chose these different hours. This insect seems to have a very low locomotor activity on plants from 4 pm to 6 pm, since it was caught in large numbers at this time of day. According to Fohouo et al. (2014), insects are very abundant on *Arachis hypogaea* in the morning and in the evening. However, during the hot hours of the day from 12 am-2 pm, a small number of *R. mica* individuals were captured. The movements of insects seem to be conditioned by the importance of sunshine. Which would make them very active at these times. This could explain the small catch of *R. mica* between 12 am and 2 pm. According to Maw et

al. (2000), leafhoppers are more mobile on sunny days in vineyard plots. The importance of the locomotor activity of this insect can allow it to be safe from its natural enemies.

Conclusion

The results obtained indicate that *Recilia mica* vector of blast disease in oil palm tree nursery visits a range plant species belonging to various families depending on the environments studied. Around the nursery, 14 plant species and 15 plant species around the plantation were inventoried. These plants belong to the families Onagraceae, Asteraceae, Rubiaceae, Commelinaceae, Convolvulaceae, Poaceae, Fabaceae, Cyperaceae, Cappadariaceae Euphorbiaceae, Amaranthaceae, Tiliaceae, Asclepiadaceae, Malvaceae and Mimosaceae. The study of the comparison of the plant families according to the number of *R. mica* showed that the Poaceae are the most visited plants around the nursery. The hypothesis that the plants frequented by these insects are Poaceae is verified in this medium. However, this is not the case around the plantation. This study should be continued to verify this hypothesis at the planting level. Two main activities of *R. mica* were determined during this study. The sap of about 60% of the plants visited around the nursery serves as food for these insects. In contrast, around the plantation, insects feed on about 40% of the plants used. However, plants on which *R. mica* has reproductive activity could not be identified. This study should be continued in order to identify the plants on which *R. mica* has reproductive activity. The study of the temporal dynamics of *R. mica* on plants according to the time of the capture has shown that this insect can be found on a range plants around the plots whatever the time of capture. The study made it possible to know *R. mica* refuge plants. They are *Digitaria horizontalis, Pueraria phaseoloides, Panicum maximum, Oldenlandia herbacea, Ageratum conyzoides, Ipomea eriocarpa, Eleusine indica, Cynodon dactylon, Sporobolus pyramidalis*. A complete study of *R. mica*'s biology will have to be carried out in order to have a thorough knowledge of this dangerous oil palm pest.

COMPETING INTERESTS

The authors state that there is no competing interest.

AUTHORS' CONTRIBUTIONS

Conceptualization: BDA; investigation, writing original draft: BDA, AHN, NFH, KY; species identification: BDA, KK; writing, review and editing: BDA, KY, AHN, NFH, KK.

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