





ARTICLE

Ornamentals of Rubiaceae Family: current status and potency evaluation of its phytocoenosis for dooryard gardening in Martinique

Plantas ornamentais da família Rubiaceae: estado atual e avaliação da potência de sua fitocenose para jardinagem de quintais na Martinica.

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Abstract: The Rubiaceae constitute the fourth largest family of flowering plants in the world. It is a cosmopolitan family, present on all continents but a large part of its diversity is located in tropical and subtropical regions. Some species of the family are considered among the most beautiful and popular in the world, but there is little data on the importance and contribution of ornamental Rubiaceae to the thriving global ornamental plant market. The island of Martinique located in the Lesser Antilles archipelago in the Caribbean, hosts part of this diversity of the Rubiaceae family. Despite significant imports of ornamental plants to the French West Indies, these species are almost non-existent in private gardens in Martinique, with the exception of the genera *Ixora*, *Mussaenda*, and *Gardenia*. Using ethnobotanical surveys, we demonstrate that the Rubiaceae family contributes only very weakly to the diversity of ornamental plants in private gardens in the north of the island.

Keywords : aesthetics, botany, ecology, floristic diversity.

Resumo: Rubiaceae é a quarta maior família de plantas com flores do mundo. É uma família cosmopolita, presente em todos os continentes, mas grande parte da sua diversidade está localizada em regiões tropicais e subtropicais. Algumas espécies da família são consideradas entre as mais belas e populares do mundo, mas há poucos dados sobre a importância e contribuição de exemplares ornamentais da família Rubiaceae para o próspero mercado global de plantas ornamentais. A ilha da Martinica localizada no arquipélago das Pequenas Antilhas, no Caribe, abriga parte desta diversidade da família Rubiaceae. Apesar das importações significativas de plantas ornamentais para as Índias Ocidentais Francesas, estas espécies são quase inexistentes nos jardins privados da Martinica, com exceção dos gêneros *Ixora*, *Mussaenda* e *Gardenia*. Utilizando levantamentos etnobotânicos, demonstramos que a família Rubiaceae contribui apenas muito fracamente para a diversidade de plantas ornamentais em jardins privados no norte da ilha.

Palavras-chave: botânica, diversidade florística, ecologia, estética.

Introduction

Rubiaceae are the fourth largest family of flowering plants in the world, with almost 14,000 species in approximately 615 genera (Claude et al., 2023; Razafimandimbison and Rydin, 2024). It is a cosmopolitan family, present on all continents but a large part of its diversity is localized but unevenly distributed in tropical and subtropical regions (Claude et al., 2023; Razafimandimbison and Rydin, 2024). All physiognomic types are represented within this family, ranging from trees, herbs, lianas, shrubs, bushes and epiphytes, including aquatic species (Claude et al., 2023). These species occupy a very wide range of habitats ranging from coastal to very high peaks, from dry or desert regions to tropical rainforests (Claude et al., 2023; Razafimandimbison and Rydin, 2024). Rubiaceae are known throughout the world for their multiple uses (medicinal, food, industrial, cultural, scientific, etc.), linked to their extremely varied chemical compositions (Dubey and Prakash, 2021; Kagisha et al., 2021; Chaniad et al., 2022; González-Castelazo et al., 2023; Jaafar et al., 2023; Roy et al., 2023; Rushdan et al., 2023; Joseph et al., 2024). Some species of the family have a high economic value, such as coffee trees, others are known as some of the most beautiful and popular tropical ornamental plants in the world, such as the genera *Ixora*, *Gardenia*, *Mussaenda*, *Portlandia*, *Serissa* (Maiti et al., 2015; Putri et al., 2021). The ornamental plant market in the world is a flourishing sector since in 2021 it was estimated at about USD 50.28 billion and would represent in 2024, USD 54,7 billion

(Business Research Insights, 2024). However, it is difficult to quantify the contribution of Rubiaceae to the global ornamental plant market, despite their remarkable diversity. The “neotropical” zone including the island Caribbean corresponds to one of the most important “hot spots” for the Rubiaceae family (Claude et al., 2023).

The Lesser Antilles archipelago located in the Caribbean and including the island of Martinique hosts part of this diversity (Claude et al., 2023). Around 129 species of the family have been identified in the archipelago, including around 89 species in Martinique, by combining the censuses of the American botanist Richard Alden Howard and the French botanist Jacques Fournet (Howard, 1989; Fournet, 2002). Rubiaceae are thus present on all forms of life on this French mountainous island and are found spontaneously in natural vegetation, in all bioclimates (from dry subhumid to hyperhumid), (Howard, 1989; Fournet, 2002; Claude et al., 2023). Within the flora of the Lesser Antilles and particularly in Martinique, by combining the censuses of botanists Richard Alden Howard and Jacques Fournet, approximately 35 species of the Rubiaceae family would be used for ornament; including 3 trees, 19 shrubs, 9 bushes, 2 herbaceous and 2 species without physiognomic indications (Fig. 1, Annex. 1), (Howard, 1989; Fournet, 2002).

Generally, all these Rubiaceae come from America, Africa, and Asia, they are very rarely endemic to the archipelago and are mostly rare rather than common (Table 1), (Howard, 1989; Fournet, 2002).

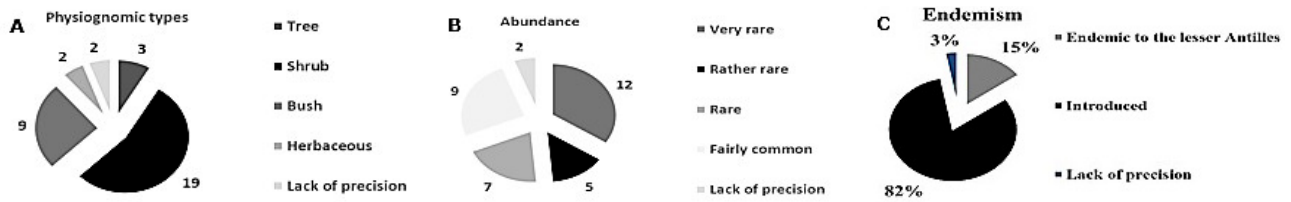


Fig. 1. A) Physiognomic types, B) abundance, and C) the origin of ornamental Rubiaceae in the Lesser Antilles (Source: Howard, 1989; Fournet, 2002).

Table 1 . Ornamental Rubiaceae in the Lesser Antilles (Fournet, 2002; Howard, 1989)

No	Genus	Species	Physiognomy	Origin/Distribution	Abundance	Uses
1	<i>Alibertia</i> A. Rich.	<i>edulis</i> (Rich.) A. Rich.	Shrub	Native to Central America.	Very rare	Ornamental and cultivated in Martinique in 1880
2	<i>Coutarea</i> Aubl.	<i>hexandra</i> (Jacq.) K.Schum.	Tree	Central America, South America.	Very rare	Ornamental, medicinal and cultivated in Martinique
3	<i>Gardenia</i> Ellis	<i>augusta</i> L. Merr.	Shrub	Native to China, Taiwan and Japan. Guadeloupe, St. LUCIA, present in most islands.	Rather rare	Ornamental and cultivated
4	<i>Gardenia</i> Ellis	<i>taitensis</i> DC.	Shrub	Originally from Polynesia. Guadeloupe.	Very rare	Ornamental
5	<i>Hamelia</i> Jacq.	<i>patens</i> Jacq.	Shrub	Central America, South America, Barbuda, Dominica, United States, Guadeloupe, Greater Antilles, Mexico, St. Vincent.	Very rare	Ornamental. Found here and there in the wild.
6	<i>Ixora</i> L.	<i>acuminata</i> Roxb.	Shrub	Native to Borneo. Guadeloupe.	Fairly common	Ornamental
7	<i>Ixora</i> L.	<i>casei</i>	Shrub	Native to the Carolinas Islands. St. LUCIA, Martinique.	Fairly common	Ornamental and cultivated in Martinique and St. Lucia
8	<i>Ixora</i> L.	<i>chinensis</i> Lam.	Shrub	From Far East (China, Taiwan). Guadeloupe, Marie Galante.	Fairly common	Ornamental and cultivated commonly grown in Montserrat
9	<i>Ixora</i> L.	<i>coccinea</i> L.	Shrub	Native to India. Guadeloupe, Marie Galante.	Fairly common	Ornamental
10	<i>Ixora</i> L.	<i>finlaysoniana</i> Wallich ex G. Don	Shrub	Native to Burma and Thailand. Guadeloupe, St. Barthelemy.	Fairly common	Ornamental. Persistent, even naturalized here and there.
11	<i>Ixora</i> L.	<i>fulgens</i> Roxb.	Bush	From Burma and the Malay Peninsula. Guadeloupe.	Rather rare	Ornamental
12	<i>Ixora</i> L.	<i>Hookeri</i> (Oudem.) Bremek.	Shrub	Native to Madagascar. Antigua, Guadeloupe.	Rather rare	Ornamental
13	<i>Ixora</i> L.	<i>javanica</i> (Blume)	Bush	Native to Indonesia (Java) and Malaysia	Fairly common	Ornamental
14	<i>Ixora</i> L.	<i>laxiflora</i> Smith	Shrub	Originally from West Africa	Very rare	Ornamental
15	<i>Ixora</i> L.	<i>longifolia</i> Smith	Shrub	Native to tropical Asia (Moluccas, Celebes). Guadeloupe.	Rather rare	Ornamental
16	<i>Ixora</i> L.	<i>pavetta</i> Andrews	Tree	Native to India, Pakistan, Bangladesh and Sri Lanka	Rather rare	Ornamental
17	<i>Leptactina</i> Hook.f.	<i>mannii</i> Hook.f.	Shrub	Native to tropical Africa. Martinique.	Very rare	Ornamental and cultivated in gardens in Martinique.
18	<i>Mussaenda</i> L.	<i>erythrophylla</i> Schum.& Thonn	Shrub	Native to Africa. Guadeloupe, rapidly changing distribution in the Lesser Antilles.	Fairly common	Ornamental and cultivated
19	<i>Mussaenda</i> L.	<i>flava</i> (Verdcourt) Bakh.f.	Bush	Native to tropical Africa	Rare	Ornamental and cultivated
20	<i>Mussaenda</i> L.	<i>frondosa</i> L.	Bush	Native to tropical Asia (Indochina, Malaysia). Martinique.	Very rare	Ornamental and cultivated in Martinique.

21	<i>Mussaenda</i> L.	<i>philippica</i> A.Rich.	Bush	Originally from the Philippines. Guadeloupe.	Rare	Ornamental
22	<i>Mussaenda</i> L.	<i>pubescens</i> Dryand	Bush	Native to tropical Asia (China, Taiwan)	-	Ornamental. Probably cultivated by some amateurs
23	<i>Mussaenda</i> L.	<i>treutleri</i> Stapf	Shrub	Native to tropical Asia	-	Ornamental. Probably cultivated by some amateurs
24	<i>Mussaenda</i> L.	<i>x rosea</i> hort.	Bush	Origin unknown. Guadeloupe.	Fairly common	Ornamental
25	<i>Neolamarckia</i> Bossier	<i>cadamba</i> (Roxb.) Bossier	Tree	Native to South East Asia, introduced for wood production. Guadeloupe.	Rare	Ornamental, cultivated (wood). Planted here and there for ornamentation (even in hygrophil forest).
26	<i>Oxyanthus</i> DC.	<i>longiflorus</i> hort.ex Lem.	-	Originally from Cuba. Guadeloupe.	Very rare	Ornamental and cultivated
27	<i>Pentas</i> Benth.	<i>lanceolata</i> (Forssk.) Deflers	Bush	Native to East Africa and Yemen. Guadeloupe, Montserrat, and probably many other islands.	Fairly common	Ornamental and cultivated. Escaped here and there. Cultivated in Martinique and other islands of the Lesser Antilles.
28	<i>Portlandia</i> P. Br.	<i>grandiflora</i> L.	Shrub	Jamaica endemic, Barbados, Grenada. Martinique.	Rare	Ornamental and cultivated on some properties in Martinique.
29	<i>Posoqueria</i> Aubl.	<i>latifolia</i> (Rudge) R.&S.	Shrub	Native to Mexico in Brazil, and Trinidad. Antigua, St. Vincent.	Rare	Ornamental and cultivated
30	<i>Psychotria</i> L.	<i>gardenioides</i> (Scheidw.) Standl.	Herbaceous	Native to Mexico, South America.	Very rare	Ornamental and cultivated
31	<i>Randia</i> L.	<i>dumetorum</i>	Bush	Native to India, China and Africa, (Zimbabwe, Mozambique, South Africa). Guadeloupe.	Rare	Ornamental
32	<i>Randia</i> L.	<i>formosa</i> (Jacq.) K. Schum.	Shrub	Native to Martinique? Guadeloupe.	Rare	Ornamental. Slopes of the Vauclin Mountain
33	<i>Rondeletia</i> L.	<i>odorata</i> Jacq.	Shrub	Native to Cuba and Panama. Guadeloupe.	Very rare	Ornamental
34	<i>Serissa</i> Comm. Ex Juss.	<i>foetida</i> (L.f.) Lam.	Herbaceous	Native to Southeast Asia and Japan. Guadeloupe.	Very rare	Ornamental and cultivated
35	<i>Thogseennia</i>	<i>lindeniana</i> (A. Rich.) Aiello	-	Native to Cuba. Martinique.	Very rare	Ornamental and cultivated in Martinique in 1880.

In Martinique, the private gardens are today very diversified and result from an evolution and significant transformations marked by the history and the cultural and socio-economic influences that the island has known (Marc, 2011; Marc and Martouzet, 2012; Lemoigne, 2016).

There are traditional Creole gardens, ornamental gardens, vegetable gardens, and permaculture spaces (Marc, 2011; Marc and Martouzet, 2012; Lemoigne, 2016). The ornamental plant sector is very flourishing in the French Antilles, since the value of imports of ornamental plants in 2021 amounts to approximately 1.9 million euros (DGCCRS, 2024). However, it is difficult to indicate the importance of Rubiaceae in this sector, and this is why we wanted to study their importance in the private gardens of Martinique. The objective is to evaluate the effectiveness of the diversity of ornamental Rubiaceae for local gardening in Martinique, to

establish a current state of the situation, and to study the plant-human link. This study also allows to complete the study conducted on the Rubiaceae family of the Lesser Antilles, particularly in Martinique.

Material

Martinique is a French island located in the Lesser Antilles archipelago, in the Caribbean. This island extends approximately 60 km from north to south and 30 km from east to west, and presents multiple natural and cultural facets over a small area of 1,128 km². The geomorphology of the island is in fact very contrasting with the mountainous northern part, made up of the most important and recent volcanic massifs; the southern part is made up of hills not exceeding 500 meters in altitude while the only plains are located in the center of the island (Fig. 2 and 3).

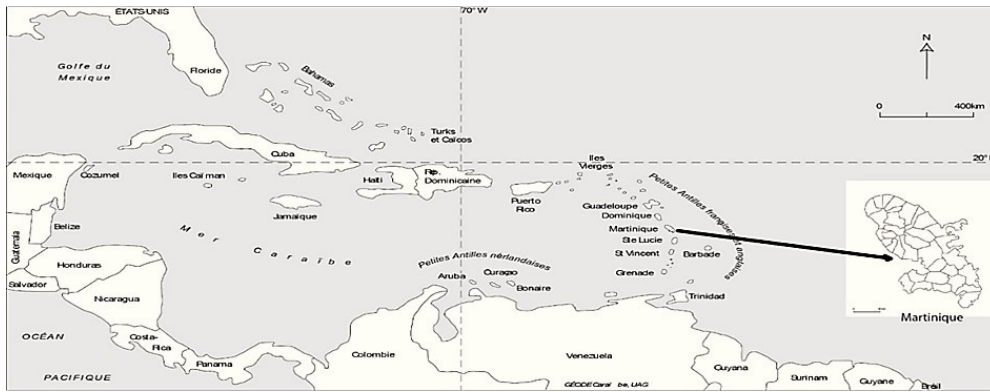


Fig. 2. Location of Martinique in the Caribbean.

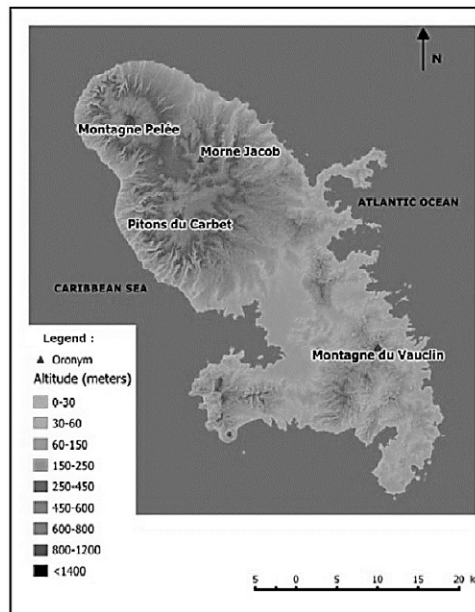


Fig. 3. Hypsometric map of Martinique. (Source: IGN).

The climate is humid tropical, with two seasons: “dry season” from February to March and “rainy and storm season” from July to October (C3AF, 2024). The island is subject to the same air mass but its topography

generates very contrasting orographic rainfall on the island, leading to the establishment of various bioclimates which in turn condition a layering of plant formations, (Fig. 4), (Joseph, 2015; Joseph et al., 2020).

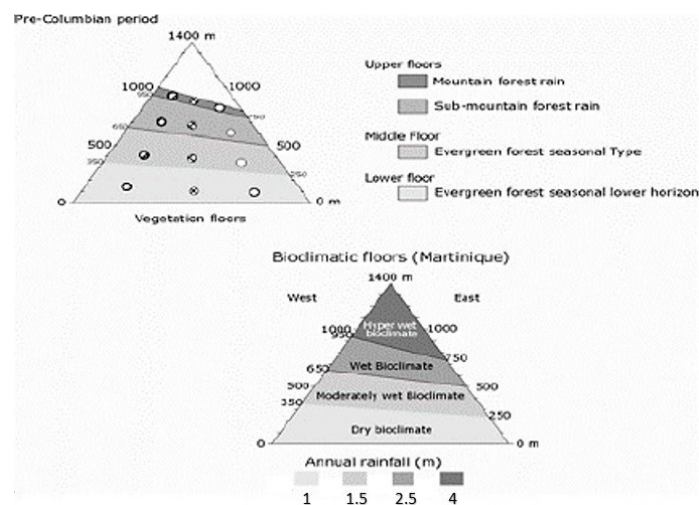


Fig. 4. Ecosystem potential and bioclimates of the mountainous Lesser Antilles (Source: Joseph, 2015)

The island is also distinguished by strong urbanization, concentrated in coastal areas and particularly around the agglomeration of Fort-de-France, the capital city located in the center of the island. According to INSEE (National Institute of Statistics and Economic Studies in France), as of January 1, 2021, the population of Martinique was 360,700 inhabitants (INSEE, 2021). The island has an average annual population decline of 0.9%. This is mainly due to a migration deficit, caused by the departure of young people who leave the island to continue their studies

or seek employment in mainland France (INSEE, 2021). Martinique nevertheless remains densely populated with 320 inhabitants per km² but massive departures and the aging of the population contribute to negative demographic dynamics. The natural balance, although positive, is declining due to an increase in deaths and a drop in births (INSEE, 2021). The north of Martinique is going through a phase of contrasting demographic and urban transformation and illustrates the overall situation of the island (Fig. 5).

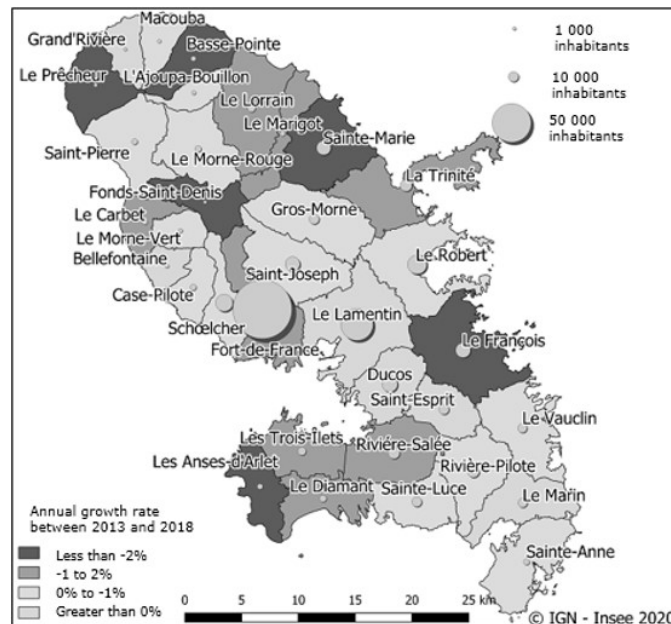


Fig. 5. Population and annual change by municipality between 2013 and 2018, in percentage (Source: IGN-INSEE, 2020).

Municipalities on the northern Atlantic coast such as Sainte-Marie, Le Marigot and La Trinité are experiencing notable demographic growth thanks to tourist development and the construction of residential infrastructure. On the other hand, municipalities located inland, often former agricultural areas, face stagnation or a decrease in their population due to rural exodus and lack of economic opportunities (INSEE, 2021). The rugged topography of the interior and the UNESCO World Heritage listing of the mountain ranges of northern Martinique also limit urban expansion to the coastal fringe, where most of the inhabitants settle (Gros-Desormeaux et al., 2019). According to the 2021 INSEE census, the north of Martinique has more than 100,000 inhabitants, or 185 inhabitants per km² and the population is mainly urban and coastal (82.4%). The population is aging despite 29.4% of the inhabitants who are under 20 years and 14.7% aged 65 and over. Workers are the most represented

socio-professional category (23.7%), followed by employees (22.1%) and retirees (20.6%). Executives and higher intellectual professions represent only 8.1%. The median income per household in this region is 24,340 euros per year, slightly lower than the average for Martinique (INSEE, 2021). In summary, the north of the island is experiencing contrasting and unique urbanization, marked by the search for a balance between the preservation of biodiversity, economic development, and demographic dynamics.

Methods

We have reduced our study area to the northern part of Martinique, because we find urbanized, peri-urban and rural areas, we also observe all the bioclimates of the island and the different associated plant formations (Fig. 6).

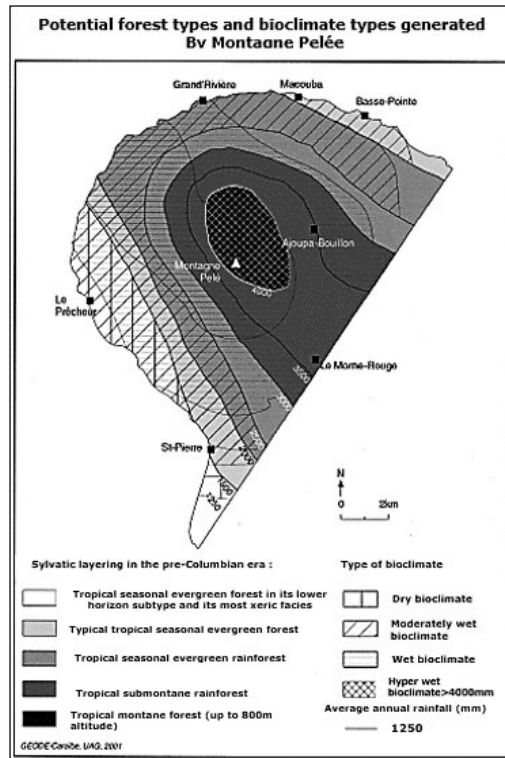


Fig. 6. Potential forest types and bioclimate types generated by Montagne Pelée (Source: Geode Caraïbe, University of the Antilles, 2001).

We have drawn transects (fictitious lines) on the map of northern Martinique, representing our route for carrying out our ethnobotanical surveys of the population. Transect No. 1, along the «west-east» axis, passes through the following municipalities: Saint-Pierre, Morne-Rouge, Ajoupa-Bouillon and Basse-Pointe. This transect starts from the town of Saint-Pierre at the level of the Caribbean Sea, reaches its highest point at the level of the town of Le Morne Rouge at almost 1000 meters altitude, then descends to the level of the Atlantic Ocean, in the town of Basse-

Pointe (Fig. 7). The transect N° 2, starts from the commune of Prêcheur towards that of Saint-Pierre, following the «north-south» axis and along the littoral part, without ever exceeding 200 meters of altitude (Fig. 7).

The ethnobotanical surveys consisted of carrying out semi-structured interviews following a random sampling method (Ganassali, 2014). We therefore interviewed the residents we met on our route, going door to door along our transects, without ever going back. These surveys were carried out using a previously established questionnaire (Fig 8).

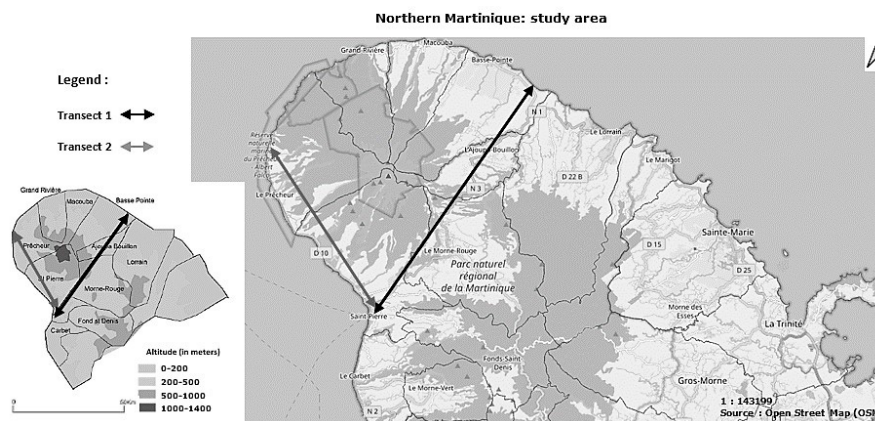


Fig. 7. Location of the study area.

QUIZ
Ecological and socio-economic importance of ornamental Rubiaceae in the Lesser Antilles : the case of Martinique.

IDENTIFY :

1. Sex : Man Woman

2. Profession :

GARDEN :

1. Location and function (use) of the garden :

2. How do you maintain your garden ?

Weekly watering 1 2 3 4 More

Monthly Plant Pruning 1 2 3 4 More

Annual fertilizer 1 2 3 4 More

Other ?

3. Do you reproduce your plants yourself ?

4. How much do you budget for your garden ? Can you specify the expense items ?

Less than 50 euros 50 to 100 100 to 200 200 to 300 300 to 400

More than 400 None

RUBIACEAE :

1. Do you know the Rubiaceae family ? Yes No

2. Do you know the following genres and specify which ones ? *Ixora, Mussaenda, Gardenia, Hamelia, Pentas, Randia, Serissa, Rondeletia, Portlandia, Albertia, Coutarea, Neolamarckia, Thonsonnia, Posoqueria...* Yes No

3. Do you have ornamental plants ? Yes No

If so, which ones ? Can you identify them in the photos and/or show them to us ?

4. For each species, how many individuals do you have ?

5. Why did you choose Rubiaceae ?

Color Easy maintenance Morphology (tree, shrub) Other

6. Can you explain this choice ?

7. What use do you make of your Rubiaceae ? Hedges Embankments Bushes

Other ?

8. At what level do you estimate the maintenance constraints of ornamental Rubiaceae ?

Very difficult Difficult Medium Easy

Fig. 8. Questionnaire used for the population survey

This included the following elements: the identity of the individual (sex, profession); the characteristics of the garden (location, function, maintenance, budget allocated, etc.); knowledge and use of ornamental

Rubiaceae (Fig 8). These elements should allow us to define the importance of ornamental Rubiaceae and their ways of integration into private gardens. We also took the liberty of systematically showing the interviewees photographs of the main ornamental plants (Rubiaceae or not), so that they could identify those that they knew and used or show them to us in the garden. The risk of error in determining the species is reduced in this way. This study also allowed those interviewed to learn about the subject in its different forms through our discussions, to understand our objectives, and to be more inclined to participate in the study. Once the surveys were completed, we entered the data and then carried out computer processing using the Sphinx software (Ganassali, 2014). Responses were collected using rapid entry. The “processing and analysis” section of the software made it possible to quickly analyze the information, and then create various illustrations such as dynamic cross tables. All of the results emitted by the software were then interpreted and analyzed in light of our knowledge of the study area.

Results

1 .Population Description

Our study sample is made up of a total of 90 people, who met and interviewed in the five municipalities crossed by the two transects (Table 2).

Table 2. Geographic distribution of respondents.

Municipalities	Number of residents interviewed	Percentage
Ajoupa-Bouillon	18	20%
Basse-Pointe	10	11%
Morne-Rouge	17	19%
Prêcheur	21	23%
Saint-Pierre	24	27%
Total	90	100%

The population surveyed is predominantly elderly and composed mainly of women, mainly retired widows (Fig. 9 and 10). However, there are people from various professions, both in the private sector and the public sector (Fig, 10).

Distribution of genders interviewed

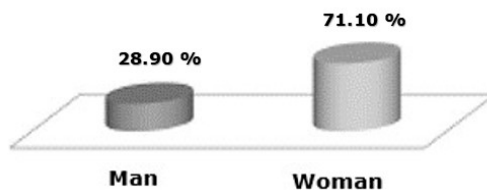


Fig. 9. Distribution of genders interviewed.

Distribution by profession

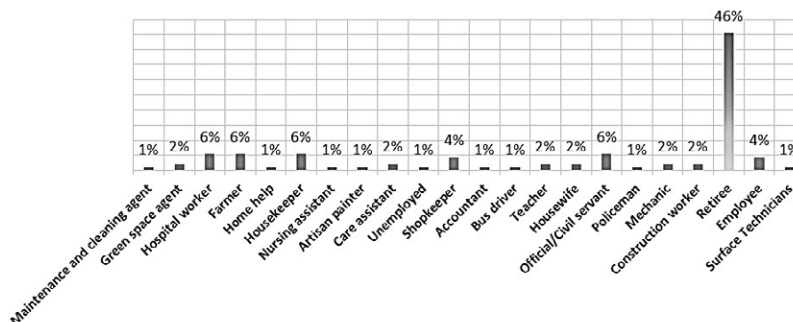


Fig. 10. Distribution of respondents by declared professions.

2. Characteristics of the gardens

All the people we met told us that their garden essentially had an ornamental function, however, 27% of them indicated that they also used it as a vegetable garden (Table 3).

Table 3. Function of the garden

Function of the garden		
Function	Number of residents	Percentage
Ornamental	90	100%
Vegetable garden	24	27%
Total	90	100%

These are mainly retired people but we also find one or two people from various trades (Table 4, Fig. 11). Regardless, the majority of the population uses the garden primarily as an ornament.

Table 4. Distribution by profession and using the garden as a vegetable patch.

Use of the garden as a vegetable garden, depending on the professions		
Professions	Number of residents	Percentage
Green space agent	2	2%
Farmer	2	2%
Artisan painter	1	1%
Care assistant	2	2%
Shopkeeper	1	1%
Accountant	2	2%
Housewife	1	1%
Retiree	12	13%
Surface technicians	1	1%
No vegetable garden	66	73%
Total	90	100%



Fig. 11. Example of an ornamental garden with the vegetable garden included in Martinique.

Due to very high rainfall in most municipalities in the north of the island, with the exception of coastal municipalities with lower annual rainfall totals, particularly on the Caribbean coast, we note that more than half of the population does not use watering for their gardens (52%), or very little (25.5%), while 22% still consider it necessary to water every day of the week (Table 5, Fig. 12).

Also, 58.89% of the population does not use fertilizers or other substances used alone or in mixtures and intended to provide plants with additional nutrients, to improve their growth and yield (Fig. 13).

Table 5. Frequency of watering.

Frequency of watering		
Number of times per week	Number of residents	Percentage
0	47	52%
1	4	4%
2	14	16%
3	2	2%
4	3	3%
7	20	22%
Total	90	100%

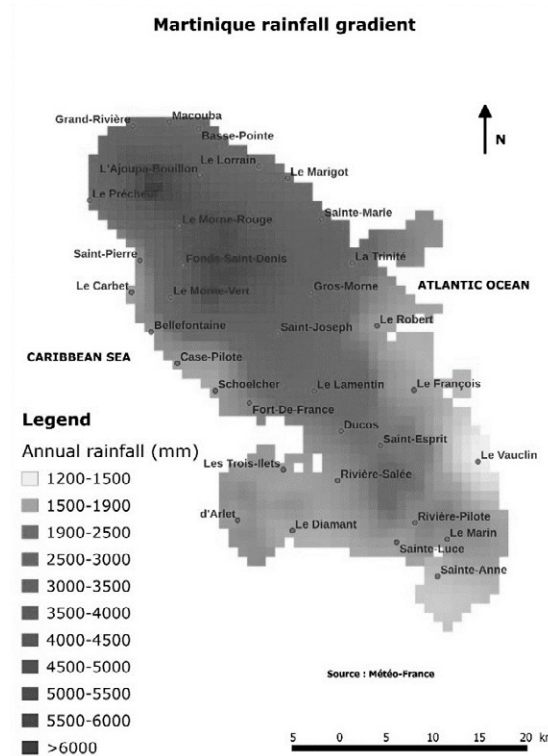


Fig. 12. Martinique rainfall gradient.

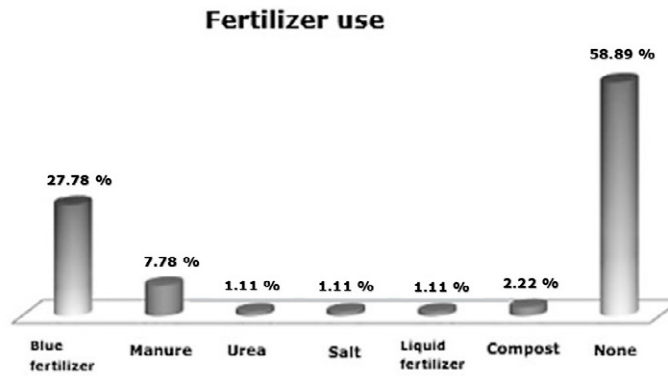


Fig. 13. Fertilizer use.

Only 27.78% use blue fertilizer and 13.33% use manure, salt, urea, liquid fertilizer, or even compost (Fig. 13). Moreover, 60% of them say they do not spend any budget on their garden, whatever the use (Fig. 14).

On the other hand, around 11% of those questioned spend a budget of less than 50 euros per year, 13% between 50 and 100 euros, 13% between 100 and 400 euros and only 2% more than 400 euros per year (Fig. 14).

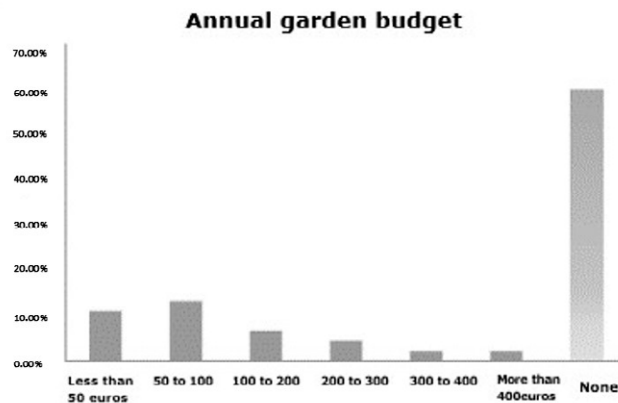


Fig. 14. Annual budget devoted to the garden.

In general, cuttings are the most widespread and ingrained practice, because 56% of people reproduce their plants themselves, either with the aim of continuing to beautify their gardens or to provide plants to the neighborhood, a passerby, or even a family member wishing to have the same plant in their home. This very ingrained practice goes against the purchasing system and reveals a system of self-reliance that persists in the north of Martinique (Table 6).

Table 6. Percentage of the population reproducing their own plants

Reproducing plants yourself	Number of residents	Percentage
Yes	50	56%
No	40	44%
Total	90	100%

Importance of Ornamental Rubiaceae

Within the surveyed population, the Rubiaceae family is almost completely unknown (Fig. 15).

The term Rubiaceae meant absolutely nothing to the majority of people surveyed, yet 72% of them knew the genus *Ixora* (Fig. 16).

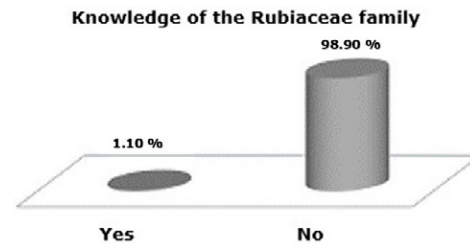


Fig. 15. Percentage of respondents knowing the Rubiaceae family.

Knowledge of the genera of the Rubiaceae family

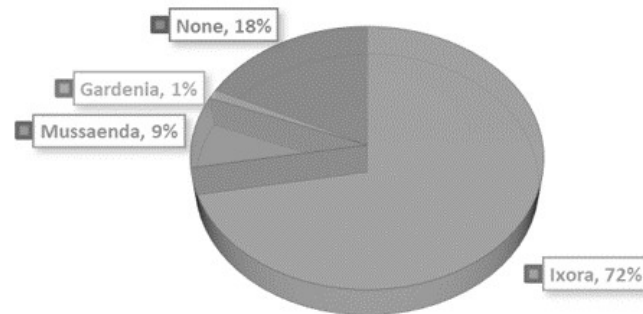


Fig. 16. Percentage of respondents knowing the genera of the Rubiaceae family.

On the other hand, it is the only relatively well-known genus of the Rubiaceae family, because only 9% know the *Mussaenda* genus and 1% the *Gardenia* genus (Fig. 16). 18% of those questioned confirmed that they did not know any genus of the Rubiaceae family, whether ornamental or not (Fig. 16). Despite blatant ignorance on the part of the majority of the population surveyed regarding the Rubiaceae family and ornamental species within the family, we note that 79% of people nevertheless have Rubiaceae in their gardens (Fig. 17). 67% have *Ixora*, 11% *Mussaenda* and only 1% *Gardenia*. These genera constitute the main ornamental

Rubiaceae used in gardens, however 1/5th of the gardens visited do not contain any Rubiaceae (Fig. 17).

In fact, 21% of the gardens visited have no species or individual of the Rubiaceae family; on the other hand, 67% of gardens have at least 1 to 7 and very rarely more than 7 individuals belonging to any species of the Rubiaceae family (Table 7).

The maintenance of ornamental Rubiaceae is almost unanimously assessed by those surveyed as being easy regardless of the study area (Fig. 18).

Number of residents with ornamental Rubiaceae in their gardens

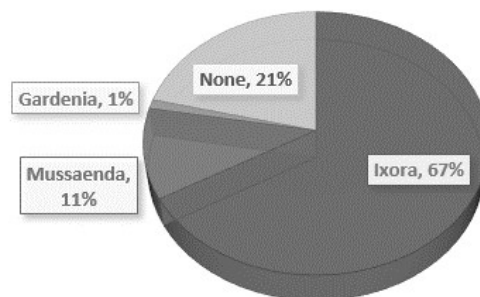


Fig. 17. Number of residents with ornamental Rubiaceae in their gardens.

Table 7. Number of individuals belonging to the Rubiaceae family, counted in private gardens.

Number of individuals belonging to the Rubiaceae family (all species combined) in private gardens		
Interval	Number	Percentage
None	19	21%
1 to 7	60	67%
7 to 13	5	6%
14 to 20	4	4%
More than 20	2	2%
Total	90	100%

Estimation of the level of constraints for the maintenance of ornamental Rubiaceae in gardens

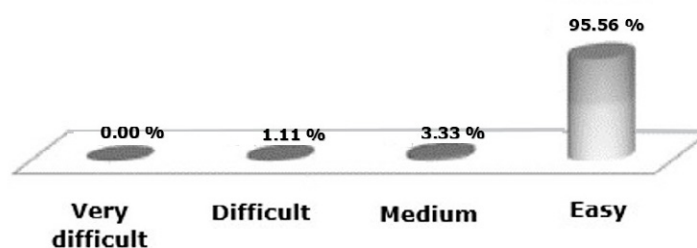


Fig. 18. Estimated level of constraints for the maintenance of ornamental Rubiaceae.

It seems that the majority of ornamental Rubiaceae found in gardens were chosen for their colors (76%) and then for their morphology (20%), (Fig. 19). These species are therefore surprisingly few chosen for their

ease of maintenance, and their presence is not trivial and corresponds to a choice! In fact, 91% of people justify their choice of Rubiaceae by the fact that they further beautify the garden (Fig. 19).

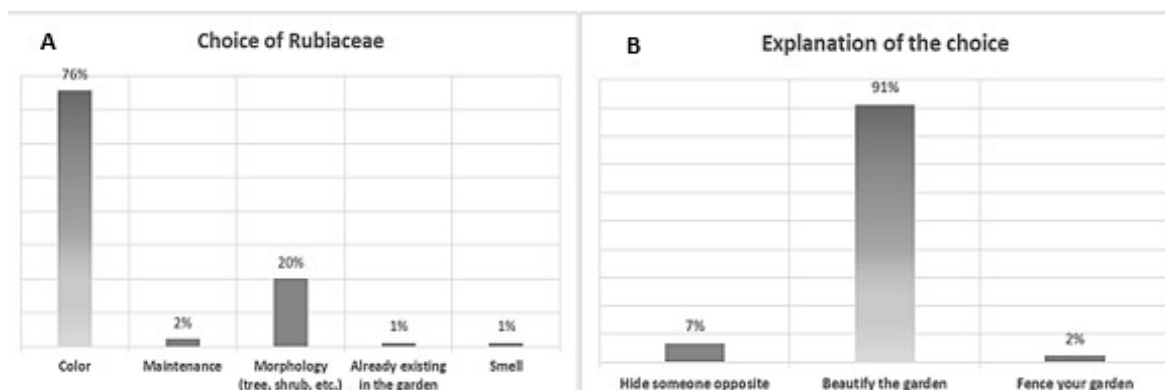


Fig. 19. A) Choice of Rubiaceae; B) Explanation of the choice.

It is interesting to note that if 20% of the people questioned declared that they chose their Rubiaceae for their morphology, only 7% indicated that it was to hide someone opposite and 2% to fence their garden (Fig.

19). However, they are mainly used in the form of trimmed bushes (47%) and the form of hedges (21%), (Fig. 20). Unfortunately, no data could be established concerning the budget devoted strictly to Rubiaceae.

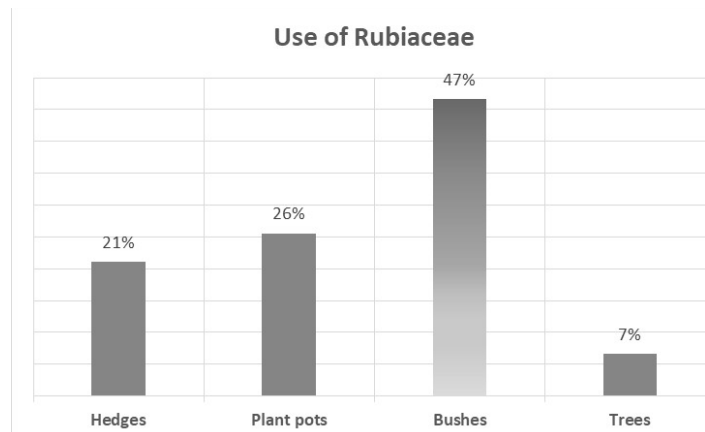


Fig. 20. Use of Rubiaceae.

Discussion

The results of our study are based on a small sample of 90 people but presenting very diverse profiles, including elderly people or active people representing various professions. This sample thus offers an interesting and almost representative perspective of Martinique society. The data show, for example, that almost half of the respondents are retired people and especially women, corroborating INSEE statistics on aging and the structuring of the population in Martinique and particularly in the north of the island (INSEE, 2021). Our results show that the majority of the population is not familiar with the Rubiaceae family. The recognition of these species was done mainly from photos and presentation models, only the genus *Ixora* was fairly well recognized, demonstrating the ignorance of this family by the population. However, only 21% of those surveyed did not have any species of the family in their garden and more than 79% owned them. The *Ixora* were in fact predominantly present, although the inhabitants reported that the excess water linked to heavy rains caused them to perish. The other genera identified: *Mussaenda* or *Gardenia* were rare and often unknown. The genera *Ixora*, *Mussaenda* and *Gardenia* are therefore the only genera of the Rubiaceae family identified in the context of this study, as being used for ornament. Their presence is not trivial because they are considered among the most beautiful flowering plants, beautifying gardens and their maintenance is considered not binding.

These ornamental Rubiaceae are mainly used in the form of trimmed bushes or hedges for ornamental reasons and rarely to hide from view or to enclose gardens. We have not found *Hamelia patens* in private gardens, this ornamental Rubiaceae which would be potentially invasive and which is more often indicated as “escaping from gardens and present in the wild in natural vegetation” (Howard, 1989; Fournet, 2002; Kaushik and Singh, 2020; Noor et al., 2020; Claude et al., 2023). However, populations of this species can be found mainly in Saint-Pierre and Fort-de-France. It colonizes ruins and rocky areas, demonstrating a strong capacity for adaptation. In the municipality of Morne-Rouge, the gardens are mainly decorated with rose bushes and hibiscus, and have a neat and orderly appearance, often without space for vegetable gardens. However, aromatic and medicinal plants, such as Basil, are present. In the commune of Ajoupa-Bouillon, we noted a prevalence of apartments but when gardens exist, they are well maintained and flowered but there are few vegetable gardens. In the municipality of Basse-Pointe, *Ixora* are particularly prized, because of their red color, important for Hindu religious practices.

Gardens are often maintained by the children of elderly people, if they are present and devote time to them. At the municipality of

Prêcheur and the municipality of Saint-Pierre, the gardens are also embellished with various flowers but often supplemented by vegetable gardens. In summary, gardens primarily reflect the personality, age and socio-economic conditions of those who maintain them (Marc, 2011; Marc and Martouzet, 2012; Lemoigne, 2016). Thus, elderly people, who love plants but are incapable of maintaining them alone, unwillingly leave their gardens abandoned. Few people are self-sufficient in the north of the island, and the traditions of growing vegetable gardens are not maintained (Marc, 2011; Marc and Martouzet, 2012; Lemoigne, 2016; INSEE, 2021). The budget allocated to gardens is often zero, in fact 60% of people allocate no budget to it. There is a strong tendency towards the absence of watering and the total absence of use of fertilizers or other substances used alone or in mixtures. The use of insecticides and other commercial products is rare because residents use artisanal practices to combat pests. Plant exchanges also take place mainly within communities and families, in the form of exchanges of seeds or cuttings, as part of a mutual system that persists as best it can from generation to generation (Marc, 2011; Marc and Martouzet, 2012; Lemoigne, 2016).

Our study suggests that Rubiaceae have no significant economic weight in Martinique. However, we know that certain communities have a very significant use of *Ixora* for the decoration of municipalities. These plants are appreciated for their color, morphology, flowering, and ease of maintenance. They are therefore often chosen for the decoration of public green spaces or for the creation of ornamental beds and delimitation of spaces, highlighting structures such as water jets or entrances to public buildings (Fig. 21). Some municipalities sometimes obtain seeds and cuttings, directly from residents or from local nurseries and organize annual house flower competitions to promote beautification. Martinique nurseries vary in size and specialization, producing or importing numerous species such as bougainvillea, desert rose and anthuriums, as well as various Rubiaceae such as *Ixora*, *Mussaenda* and *Gardénia* (DGCCRS, 2024). The island’s major brands also participate in the resale of ornamental plants, relying on imports to meet demand. Studies have already been carried out in the past, with nurseries in Martinique on related subjects and if Rubiaceae are part of the census of ornamental plants sold on the island, their number is negligible compared to other families of ornamental plants (Soubeyran, 2008; Wittmann and Flores-Ferrer, 2015; Claude et al., 2023). Finally, despite the diversity of the family, the Rubiaceae contribute very little to the diversity of ornamental plants on the island.



Fig. 21. Example of the storefront of the municipality of Morne-Rouge in Martinique.

Conclusions

Ornamental Rubiaceae are used very little by the population of northern Martinique. They are almost non-existent in private gardens. The genus *Ixora* constitutes an exception, known for its ornamental and medicinal values, its capacity for mutation, and the appearance of new species, as well as for its history and its magico-religious uses. It is the only genus of the family that can be seen in large numbers, but *Ixoras* are frequently colonized by aphid scales and are often vectors of disease. We then find, very marginally, only the genera *Mussaenda* and *Gardenia* among the Rubiaceae used for ornament, by the residents of the north of the island. This study was carried out in the municipalities of Prêcheur, Saint-Pierre, Morne-Rouge, Ajoupa-Bouillon and Basse-Pointe, among 90 people with a garden and presenting varied profiles. The study reveals that gardens primarily reflect the personality, age and socio-economic conditions of individuals. Garden ornamentation is often based on artisanal cuttings and community assistance; some adopt a policy of self-sufficiency through mixed vegetable and ornamental gardens, which then perform both beautification and subsistence functions. Ornamental Rubiaceae intended for marketing seem mainly to be cultivated for local authorities and other local private organizations because residents mainly practice plant exchange systems and devote little budget to their gardens. Although the study does not, however, provide information on other ornamental plants, it allowed us to describe the importance of the Rubiaceae family for decorating private gardens in the north of the island. The result is that despite the diversity of the family, Rubiaceae only contribute very weakly to the diversity of ornamental plants in private gardens on the island.

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Author Contribution

CJP: conceptualization; writing. **RN:** resources. **AY:** review & editing. **JP:** review & editing.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

There is no data available, made available to readers.

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