



Occurrence of Leaf Spot Anthracnose in the Monostand of *Rhizophora apiculata* in Sitio Marabahay, Rio Tuba, Bataraza, Palawan, Philippines

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Mangrove trees are naturally resilient to pathogenic attacks with its salt tolerant mechanism, but was reported to be lowest in *Rhizophora apiculata* making it susceptible to pathogenic attacks. This study aimed to morphologically verify the fungus affecting *R. apiculata* in the area and determine the extent and severity of fungal infection present in *R. apiculata* in Sitio Marabahay, Rio Tuba, Bataraza, Palawan, Philippines.

There were at least 100 *R. apiculata* trees near the settlement area that were affected by the anthracnose. Almost 85-90% of all sampled leaves were affected by the anthracnose which indicates that the *R. apiculata* that were thriving in Marabahay, Rio Tuba, Bataraza, Palawan, Philippines were under severe threats of great lost both in terms of quality and quantity of *R. apiculata* in the area.

The occurrence of this disease in *R. apiculata* could be attributed to the humidity brought by the rainy weather during the month of October favoring the growth of fungal pathogens. The low salt-tolerance of *R. apiculata* and environmental stress brought by the waste management of the settlers in the area contributed also to the spread of the disease among the monostand of *R. apiculata*.

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Monitoring of the occurrence of this disease should be conducted frequently and water condition and other environmental factors in the settlement area should be evaluated to avoid decline of the mangrove biodiversity in the area.

Keywords: Mangrove diseases; leaves; occurrence; acid rain.

1. INTRODUCTION

Mangroves are few of the emergent land plants that can tolerate salinity of coastal water [1] and a vital floral ecosystem in tropical coastal communities such as the Philippines [2]. Mangroves are important source of fishery (seaweeds, fish, crabs, prawns, mollusks and other invertebrates) and forestry (timber, firewood, tanbark for dyes, fibers and ropes, corks, etc.) products. Mangrove amenities include coastal protection from typhoons and storm surges, erosion control, flood regulation, sediment trapping, nutrient recycling, wildlife habitat, and nurseries [3,4]. Mangroves particularly *Rhizophora apiculata* contain anti-inflammatory properties and is also an important source of traditional medicines [5].

In 2014, threats to this important resource were identified to include direct collection for timber, firewood and charcoal making, tanbark gathering and land conversion for purposes of fishpond establishment, tourism infrastructure and encroachment for settlement [6]. However, one major biological threat to this resource especially to the *R. apiculata* stand was identified to be the occurrence of pathogenic diseases [4].

Leaf spot anthracnose is a fungal disease known to be caused by infection from *Colletotrichum* and *Pestalotiopsis* [7,8]. The disease was documented to be infecting the mangrove stand in Guanxi, China, but of different symptomatic manifestation per species [9] and also in Vietnam effecting *Sonneratia apetala* and *Sonneratia caseolaris* [10].

The mangrove areas of Palawan is a declared mangrove swamp forest reserved as early as 1981 by virtue of Presidential Proclamation 2152 [11]. Only few reports have been made on the occurrence of disease in the mangroves area in Palawan. Further, very little is known about the effects of either widespread or localized

mangrove area loss on individual mangrove species or populations. Disease occurrence could be one of the factor for diversity lost and species or population decline not only on mangrove area but also to other aquatic animals that relies on mangroves [12]. The objectives of this study was to morphologically verify the fungus affecting *R. apiculata* in the area, and determine extent and severity of fungal infection present in *R. apiculata*, in Sitio Marabahay, Rio Tuba, Bataraza, Palawan, Philippines, last October 2019.

2. MATERIALS AND METHODS

2.1 Study Site

During one of the bi-annual site visit in the coastal area of Sitio Marabahay, Rio Tuba, Bataraza, Palawan, Philippines, the unusual damage to the foliage of the *R. apiculata* monostand was observed. A monostand of *R. apiculata* is thriving in the coastal area of Sitio Marabahay, a fishing village in Barangay Rio Tuba in Bataraza, Palawan, Philippines (Fig.1).

Sitio Marabahay is one of the 11 sitios of Barangay Rio Tuba in the Municipality of Bataraza, the southernmost municipality of mainland Palawan. Barangay Rio Tuba is also home to the Rio Tuba Nickel Mining Corporation and Coral Bay Nickel Corporation as early as 1977 and 2001 respectively.

Along the coast of Rio Tuba resides a fishing community with houses built along the fringe mangrove forest. Coastal residential houses situated in the mangrove area directly dispose of domestic waste from kitchen refuse and toilets into the receiving coastal waters. The area is likewise utilized as a boat docking area where washing and flushing of oil-laden water are dumped.



Fig. 1. Rio Tuba and its coastal community (settlement area) location map

(Source: Coral Bay Nickel

Corporation/googlemaps:<https://www.google.com/maps/place/Palawan/@11.7802056,117.9055427,6z/data=!4m5!3m4!1s0x33b5bce750b99e45:0xdfc65f6c0c8d3beb!8m2!3d9.8349493!4d118.7383615>

2.2 Sampling and Analysis

Photographs were taken in all angles and sent to plant pathology experts from the Forest Biological Science Department of the College of Forestry and Natural Resources, University of the Philippines, Los Banos, Laguna for confirmation. The type of fungal disease infecting the leaves was examined using morphological characteristics of the fungus infecting *R. apiculata*. In the absence of pathogenic isolation by culturing samples, the disease verification was limited in identifying the type of plant disease present in general and not up to species level of the fungi causing the infection.

Infected leaves were sampled and compared to the healthy leaves of the same species. Severity of the disease was then visually examined against the healthy leaf samples. The extent of the infection was based on the percentage area damage in the affected leaves.

3. RESULTS AND DISCUSSION

The infected *R. apiculata* trees were found thriving in these highly polluted waters and within the residential populace. The plant pathology experts confirmed based on the morphological characteristics of the fungus present in *R. apiculata*, that the fungus was leaf anthracnose that is caused either by filamentous fungi in the genus *Colletotrichum* or *Gloeosporium* (Fig. 2).

There were at least 100 *R. apiculata* trees in the area that were affected by the anthracnose leaf spot. Almost 85-90% of all sampled leaves were infected by the anthracnose which indicates that the *R. apiculata* that were thriving in Marabahay, Rio Tuba, Bataraza, Palawan, Philippines was under severe threats of great lost both in terms of quality and quantity (Fig. 3).

Anthracnose is a serious plant disease affecting different plants worldwide characterized by small light brown leaf spots of dead tissue which emerges on the leaves often on the leaf's vein system that causes necrotic lesions and early senescence or early leaf aging [13,14]. This disease was reported to be present in mango, avocado and rubber trees [13,15,16].

Environmental factors like temperature, relative humidity and rainfall plays a role in plant disease development and these environmental factors are being used to forecast disease severity [15, 16]. In the present study, infection of anthracnose occurred during the wet season (October 2019). The high humidity during wet season favors the development of anthracnose in the foliage and water droplets from the rain helps in the spread of the disease among the leaves, eventually killing the tress [17]. Without a fully functioning foliage, important functions for plant growth and development are impaired leading to the death of the plant [18].



Fig. 2. Leaf spot infected *R. apiculata* leaves (A) infected twig (B) ventral side of the infected leaf (C) dorsal side of infected leaf



Fig. 3. Comparison of leaf spot Anthracnose infected *R. apiculata* (A) dorsal (B) ventral

Aside from environmental factors, the salt (NaCl) tolerance mechanisms present in different mangrove species could also play a role in disease development [19]. *Avicennia*, for example, excretes salt through leaf glands and has the highest salinity of residual rainwater on leaves, *Laguncularia* which accumulates salt in the leaves has the greatest bulk of salt concentration, while *Rhizophora*, which excludes salt at the roots has little salt associated with leaves [19]. The *R. apiculata* is more salt-sensitive than the *R. stylosa* [20]. Mangrove leaves provide a unique function of filtering excess NaCl from the salty water before it can be transported and utilized for normal cell function and nutrient absorption for cellular respiration. The high salt concentrations associated with the leaves as with *Avicennia* and *Laguncularia*, were sufficient to inhibit the germination of many fungi associated with mangrove forests [19].

Recent study identified the presence of *Colletotrichum gloeosporioides* and *Pestalotiopsis uvicola* in *R. apiculata* [21]. Although in the present study, the identification of fungi causing the leaf spot were also limited to morphological characteristics, it is possible that the two mentioned above are the fungi responsible for the occurrence of anthracnose in Sitio Marabahay, Rio Tuba, Palawan.

4. CONCLUSION

The occurrence of the leaf spot in Sitio Marabahay, Rio Tuba, Palawan, Philippines, was only observed once in year 2019. The frequency of its occurrence and the severity of infection should be monitored and studied to protect the population of *R. apiculata* present in the area. Furthermore, the environmental condition in the area should also be assessed to ascertain the

influence of the local environmental condition in the growth of *R. apiculata*.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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