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DISTRIBUTION OF RUBBER LEAF FALL DISEASE IN THE SWAMP LANDS OF BARITO KUALA DISTRICT

ABSTRACT

Swamp land is a rubber development area in South Kalimantan and rubber plants are a leading commodity in South Kalimantan which is in second place after palm oil plants. Starting in 2019, the rubber industry in Indonesia experienced an outbreak of leaf fall disease. This disease causes a decrease in latex production of up to 50%, even in advanced conditions without treatment, infected plants will rot and die. The aim of this research was to study the distribution of rubber leaf fall disease in the swamplands of Barito Kuala district. Survey of disease incidence and severity was carried out using a stratified random sampling method. It was observed that eight sub-districts in Barito Kuala district and Banjar district had swamp land that planted rubber. At four locations/villages in each sub-district, sample plants were taken which were determined to be 25 plants diagonally. Parameters of disease incidence and disease severity followed the International Rubber Research Development Board. The results of the research revealed that rubber leaf fall disease has spread in four rubber-plantation sub-districts. All sub-districts surveyed were 100% affected by rubber leaf fall disease. In the studied district, the rubber leaf fall disease attack is quite severe with an average disease severity of 67%.

Keywords: Distribution, Leaf fall disease, Rubber, Swamp land

INTRODUCTION

One of Indonesia's renewable natural resources is rubber. Rubber (*Hevea brasiliensis* Muell. Arg) is an important plantation commodity for Indonesia because it makes a significant contribution to the local and national economy and is a source of income for millions of farmers. Rubber plants are the largest foreign exchange contributor for Indonesia. Indonesia is the second-highest rubber-producing country in the world after Thailand. In 2021, Latex production 3,121,474 and 166,125 tons in Indonesia and South Kalimantan, respectively (Directorate General of Plantations, 2021). Based on data from the South Kalimantan Plantation Service (2021), rubber plants are the leading commodity in South Kalimantan, ranking second after oil palm plants. Three years ago, the area of rubber plantations in South Kalimantan (2021) reached 271,969 ha spread across several districts, including Tabalong District (69,543 ha), Banjar (40,202 ha), Balangan (37,901 ha), Hulu Sungai Tengah (26,064 ha) , Tanah Bumbu (24,508 ha), Tanah Laut (21,256 ha) and in several other districts in small areas.

The rubber industry in Indonesia experienced leaf fall disease which has since being an annual phenomenon. This disease could reduce rubber production by half, and in severe cases without

treatment, result in rot and eventually death of the plants (Damiri *et al*., 2022). Initially, this disease was often ignored by planters because rubber trees also experience leaf fall when water requirements decrease, such as during the dry season. According to Ardika *et al*. (2011) when leaves fall, the leaf area index decreases so that plant water consumption also decreases. This causes latex production to also decrease because the leaf area index is positively correlated with plant production. However, in rubber that is attacked by disease, fallen leaves do not grow new leaves anymore, and even in heavy attacks, the canopy wilts and the plant die (Shufen *et al*., 1999).

Starting in 2021, leaf fall disease began to be detected attacking rubber plantations in South Kalimantan. In Tabalong district 316 ha, Hulu Sungai Utara 151 ha, Kotabaru 30 ha, and Tanah Bumbu 127 ha (South Kalimantan Plantation Service (2021). However, there have been no reports of leaf fall attacks in the Baritokuala and Banjar districts (South Kalimantan Province Plantation and Livestock Service). To support the management of leaf fall disease, initial information is needed regarding the existence and spread of the disease.

Pathogens that cause rubber leaf fall disease include the fungi *Colletotrichum gloeosporioides*, *Oidium heveae*, *Corynespora cassiicola*, and *Pestalotiopsis* sp (Dalimunthe, 2015). Symptoms of leaf fall differ among causative organisms, thus, aside visible morphological features other diagnostic identification is required. For instance, *Fusicoccum* sp, *Corynespora cassiicola dan Pestalotiopsis* sp. Both exibit the same attack symptoms such as the appearance of brownish edges and concentric areas with conidia on the upper surface of the leaves (Junaidi *et al*., 2018; Simbolon *et al*., 2022). However, they differ characterized by blight symptoms that change from light to dark brown.

The aim of this research was to study the presence/incidence, disease severity, distribution and identification of the cause of leaf fall disease in swamp lands and small holder rubber plantation centers in South Kalimantan.

MATERIAL AND METHODS

This study is divided into a survey quantitative and qualitative of leaf fall disease to determine the presence and distribution of the disease, and identify the causes of leaf fall disease in swamp lands and small holder rubber plantation.

The Stratified Random Sampling method was used for the survey. It is a sampling process by dividing the population into strata, selecting random samples from each stratum, and combining them to estimate population parameters.

Survey of disease distribution

The rubber plant population in swamp land is divided into the rubber plant population in tidal swamp land and lowland swamp land. Surveys in Lebak swamp land were carried out on rubber plantations in Banjar district (3.40813134°S 114.84854166°E). A survey of tidal swamp land was carried out at a rubber plantation in Barito Kuala district (2.98114305°S 114.76677877°E). In each district, four sub-districts were selected whose rubber plants were located in swamp land with a minimum planting area of 1 ha. At each location, four villages were taken and then each village determined the planting location that would be used as a sample. Sampling was carried out diagonally so that five locations were taken as samples. At each sample location, 25 plants were observed. From each location a sample was selected randomly as much as 5% of the population plants per ha (approximately 25 trees sample). The number of rubber trees observed was 25 x 5 x 4 x 4 x 2 = 4000 plants.

Observation

The parameters observed were disease incidence and disease intensity/severity. Disease incidence is calculated using the formula:

$$Disease\ Incidence\ = \frac{\text{total number infected plants unit}}{\text{total number of plants assessed}}\ x\ 100\%$$

The disease rating scale was utilized to calculate the disease severity index (DI) per orchard using the formula DI (%)= [∑(vf)/(ND)] × 100 (McKinney 1923), where v = leaf fall severity score, f = frequency of trees with a given rating, N = total number of trees assessed in the orchard, and D is the highest disease severity score (Chaudhary *et al*., 2020)

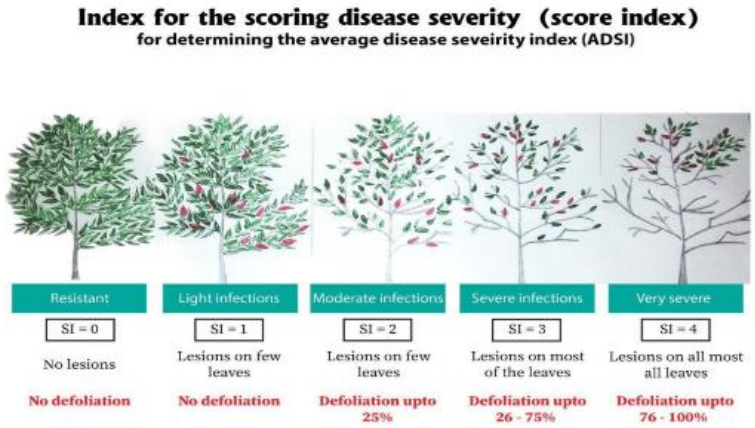

Figure 1. Scoring of observations of canopy density due to leaf fall disease in rubber plants (IRRDB, 2019 dalam Febbiyanti & Tistama 2021)

RESULTS

Based on 2021 data from the South Kalimantan Province Plantation and Livestock Service, the area of rubber plantations in South Kalimantan is 271,969 ha with immature plants (TBM), covering 52,979 ha, mature plants (TM) 203,774 ha, and old plants/damaged plants (TM/TR) covering an area of 15,216 ha. In the Regency/City, the most rubber plantations are in Tabalong Regency, covering an area of 69,543 ha, and the fewest in Banjarbaru City, covering an area of 1,121 ha, while in Barito Kuala Regency is 4,189 ha. For South Kalimantan province rubber production in 2021 will be 212,956 tons with a production of 1,045 Kg/ha. Then Barito Kuala Regency, in 2021 reached 1,655 tons with a production of 874 Kg/ha (Disbun, 2022). Based on the description of the area of rubber planting land, the following is data on the area of planting in South Kalimantan (Table 1):

Table 1. Rubber Plantation Production Data for South Kalimantan Province

No	Regency/ City	Area (Ha)				Production	
		Immature plants	Plants produce	Unproductive plants	Total	Ton	Kg/Ha
1	Tabalong	11990	52607	4946	69543	62672	1191
2	Balangan	7379	28926	1596	37901	32544	1125
3	Hulu Sungai Utara	443	401	334	1178	402	1002
4	Hulu Sungai Tengah	8100	16979	985	26064	20127	1185
5	Hulu Sungai Selatan	4406	10241	640	15287	12151	1187
6	Tapin	2734	13606	2836	19176	8679	638
7	Tanah Laut	4024	16844	388	21256	13222	785
8	Kotabaru	3146	8023	374	11543	6637	827
9	Tanah Bumbu	949	22208	1351	24508	25183	1134
10	Banjar	7808	30808	1587	40203	28105	912
11	Barito Kuala	1629	2397	163	4189	2327	971
12	Banjarbaru	371	734	16	1121	907	1236
13	Banjarmasin	0	0	0	0	0	0
	Total	52979	203774	15216	271969	212956	1045

(Disbun, 2022)

Rubber plant diseases in South Kalimantan

Generally, diseased plants show specific symptoms. Symptoms are changes shown by a plant as a result of disease. Often certain diseases do not only cause one symptom but also cause a

syndrome. Additionally, several different diseases have similar symptoms, making it difficult to diagnose definitively just by looking at the symptoms. Various plant pest organisms of rubber plants in South Kalimantan are recorded by the South Kalimantan provincial plantation service, including white root rot disease, tapping panel dryness, Mouldy Rot, and leaf spot. For leaf fall in South Kalimantan has started to become infected, there are several districts where the leaf fall disease, *Pestalotiopsis* sp., has been recorded. namely in the districts of Tabalong, Hulu Sungai Utara, Tanah Bumbu, and Kotabaru. Meanwhile, diseases in rubber plants recorded at the Barito Kuala Regency plantation service include white root fungus, tapping panel dryness, and pink disease.

Based on data from the Plantation and Livestock Service of South Kalimantan Province in 2022 (Table 2), the following is data on pests that attack rubber plants in South Kalimantan Province:

Table 2. Diseases in Rubber Plantations in South Kalimantan Province

No	Regency/City	Disease
1.	Tabalong	white root rot disease, tapping panel dryness, pink disease, *Mouldy Rot* and *Pestalotiopsis* leaf fall disease
2.	Balangan	white root rot disease, tapping panel dryness, and pink disease
3.	Hulu Sungai Utara	white root rot disease, tapping panel dryness, and *Pestalotiopsis* leaf fall disease
4.	Hulu Sungai Tengah	white root rot disease, tapping panel dryness, and pink disease.
5.	Hulu Sungai Selatan	white root rot disease and tapping panel dryness
6.	Tapin	white root rot disease dan tapping panel dryness
7.	Tanah Laut	white root rot disease dan *Mouldy Rot*
8.	Kotabaru	white root rot disease, tapping panel dryness, and *Pestalotiopsis* leaf fall disease.
9.	Tanah Bumbu	white root rot disease, tapping panel dryness, Bark nescrosis, and *Pestalotiopsis* leaf fall disease.
10.	Banjar	white root rot disease, tapping panel dryness, and pink disease

11.	Barito Kuala	white root rot disease, tapping panel dryness, and pink disease
12.	Banjarbaru	white root rot disease, tapping panel dryness, Bark nescrosis, and pink disease
13.	Banjarmasin	None

(Disbun, 2022),

Based on data from the District Plantation and Livestock Service (Table 3), the following is data on pests that attack rubber plants in Barito Kuala Regency:

Table 3. Rubber Planting Plant Pest Organisms (PPO) Data in Barito Kuala Regency

No.	Plant Pest Organisms (PPO)	Subdistrict	Extent of attack (Ha)		
			light	heavy	Amount
1.	**White root rot disease**	Tabunganen	1	-	1
		Tamban	7	4	11
		Mekar Sari	2	-	2
		Anjir Pasar	-	-	-
		Anjir Muara	1	1	2
		Alalak	-	-	-
		Jejangkit	-	-	-
		Mandastana	-	-	-
		Belawang	2	-	2
		Wanaraya	17	13	30
		Rantau Badauh	1	-	1
		Cerbon	1	-	1
		Barambai	15	14	29
		Bakumpai	-	-	-
		Marabahan	19	8	27
		Tabukan	3	-	3
		Kuripan	-	-	-
2.	**Tapping panel dryness**	Tabunganen	-	-	-
		Tamban	8	4	12
		Mekar Sari	5	3	8
		Anjir Pasar	12	15	27
		Anjir Muara	4	4	8
		Alalak	-	-	-
		Jejangkit	-	-	-
		Mandastana	-	-	-
		Belawang	2	2	4
		Wanaraya	14	16	30
		Rantau Badauh	2	4	6
		Cerbon	-	-	-
		Barambai	23	44	67
		Bakumpai	-	-	-

	Marabahan	-	-	-
	Tabukan	-	-	-
	Kuripan	-	-	-
3. Pink disease	Tabunganen	-	-	-
	Tamban	-	-	-
	Mekar Sari	-	-	-
	Anjir Pasar	-	-	-
	Anjir Muara	-	-	-
	Alalak	-	-	-
	Jejangkit	-	-	-
	Mandastana	-	-	-
	Belawang	-	-	-
	Wanaraya	18	10	28
	Rantau Badauh	-	-	-
	Cerbon	-	-	-
	Barambai	8	8	16
	Bakumpai	-	-	-
	Marabahan	10	7	17
	Tabukan	-	-	-
	Kuripan	-	-	-

In the data in Table 3, the diseases recorded in Barito Kuala district are White Root Fungus (JAP), Dry tapping Groove, and pink disease. Leaf fall disease has not been reported

Disease Incidence

The results of observations of the incidence of rubber leaf fall disease showed that rubber leaf fall disease was present in all the fields observed with a disease incidence rate of 100%. All plants observed were attacked by leaf fall disease. This detected leaf spots on all the plants observed. The condition of these spots varies, some are round in shape with clear boundaries between the diseased and healthy parts. This is found on various ages of leaves, both old and young leaves. On older leaves the spots are gray, while on older leaves the spots are light brown to dark brown. If the symptoms are severe, the leaves turn yellow and eventually fall (Figure 2). This symptom is found in all villages in each sub-district that grow rubber.

Figure 2. Symptoms of circle leaf fall disease in Barito Kuala Regency.

All rubber planting locations are almost close together and are around the Barito river. Rubber plants are not found in the entire Barito Kuala district. Rubber plantations are found in Wanaraya, Barambai, Marabahan, and Anjir Pasar District. Rubber plantations are generally not planted in large areas. The spread of rubber leaf fall disease is spread evenly throughout the sub-district.

Table 4. Incidence of rubber leaf fall disease in Barito Kuala Regency

No.	Sub District	Village	% disease incidence					avarage
			Lok. 1	Lok. 2	Lok. 3	Lok.4	Lok.5	
1	Wanaraya	Roham Raya	100%	100%	100%	100%	100%	100%
2		Kolam Makmur	100%	100%	100%	100%	100%	100%
3		Kolam kiri	100%	100%	100%	100%	100%	100%
4	Barambai	Barambai	100%	100%	100%	100%	100%	100%
5		Kolam kiri dalam	100%	100%	100%	100%	100%	100%
6		Kolam kanan	100%	100%	100%	100%	100%	100%
7	Marabahan	Antaraya	100%	100%	100%	100%	100%	100%
8		Sido makmur	100%	100%	100%	100%	100%	100%
9		Karya Maju	100%	100%	100%	100%	100%	100%
10	Anjir Pasar	Gandaria	100%	100%	100%	100%	100%	100%
11		Mentaren	100%	100%	100%	100%	100%	100%
12		Danau Karya	100%	100%	100%	100%	100%	100%
Average			100%	100%	100%	100%	100%	100%

The data in Table 5 shows that leaf fall disease has spread in Barito Kuala Regency. All rubber plants show leaf spots which are the initial symptoms, over time the leaves will turn yellow and the leaves will fall.

Table 5. Severity of leaf fall disease in Barito Kuala district

No.	Sub District	Village	Disease Severity
1	Wanaraya	Roham Raya	67%
2		Kolam Makmur	75%
3		Kolam kiri	72%
		Avarage	71%
4	Barambai	Barambai	51%
5		Kolam kiri dalam	82%
6		Kolam kanan	76%
		Avarage	70%
7	Marabahan	Antaraya	70%
8		Sido makmur	61%
9		Karya Maju	67%
		Avarage	66%
10	Anjir Pasar	Gandaria	48%
11		Mentaren	53%
12		Danau Karya	55%
		Avarage	52%
		Total Average	**65%**

The severity of leaf fall disease in the tidal swamplands of Barito Kuala Regency is quite severe on average, namely 65%. The severity at each location varied from 48% in Gandaria village, in Anjir Pasar District to 82% in Kolam Kiri Dalam village, in Barambai District. In Barambai subdistrict the average disease severity is 70%, in Wanaraya subdistrict it is also almost the same, namely 71%. In Marabahan sub-district it is lower, namely 66%. The lowest sub-district is Anjir Pasar sub-district, which is only 52%. (Table 5). The location and distribution of the disease is shown on the map of the distribution of leaf fall disease in Barito Kuala Regency (Figure 3.) In Figure 3, shown the distribution of rubber plantation locations in Marabahan, Barambai and Wanaraya sub-districts which are located in adjacent areas. Meanwhile, the Anjir Pasar sub-district with three sub-districts is separated by a river and is quite far away. Interviews with farmers obtained information that generally smallholder rubber farmers do not know which clones are being planted. Therefore, the development of swamp land is very strategic and important. The development of rubber plants is directed towards swamp land. Swamp land in South Kalimantan is in the form of tidal swamp land and lowland swamp land. Barito Kuala Regency, which the Barito River passes through, is tidal swamp land. Rubber plantations on tidal land will generally be flooded when high tides occur. In

these conditions, plants can grow well because rubber plants have good adaptability to the environment.

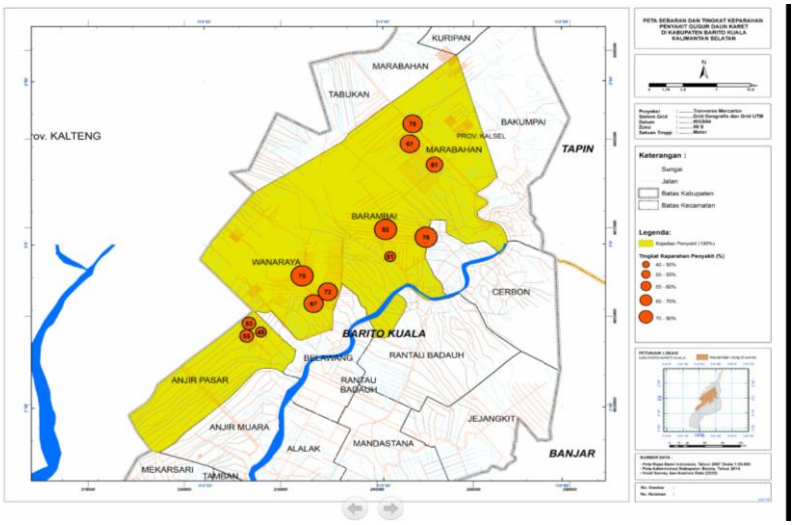

Figure 3. Distribution of Rubber Leaf Fall Disease in the Swamplands of Barito Kuala Regency

. During the dry season, rubber plants will shed their leaves. According to Ardika *et al*. (2011), rubber plants will shed their leaves if the water supply is reduced. This happens because rubber plants are plants that are able to adapt well to environmental conditions, both physical and climatic conditions. Rainfall is one of the factors that determines latex production. Suitable rainfall for the growth of rubber plants is around 2000 mm/year or more with even distribution in the same year without a dry season. The presence of rainwater affects groundwater which in turn affects latex production. Water plays a major role in plant metabolic processes, so that a decrease in soil water content results in reduced flow and latex production. The phenomenon of rubber leaf fall in the region south of the equator has a close relationship with plant water consumption. The GT 1 clone consumes more water because its roots are more numerous and extensive so water consumption also increases. This causes the GT clone to be more drought resistant.

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Under normal conditions, leaf fall can occur once or twice a year, especially during the dry season. After that the leaves will form again and return to normal. However, disease attacks cause rubber plants to drop their leaves outside of the season. Rubber plants that are attacked by leaf fall disease are easy to recognize, namely the affected leaves initially have leaf spot symptoms. Further symptoms are yellowing and falling leaves. The results mixed method research which included both

quantitative and qualitative data collection show that even though there are puddles on rubber plantation land which shows that the land does not lack water, rubber plants also shed their leaves 4 to 5 times a year. When a disease attacks, fallen leaves can sprout again, but after they are formed new leaves will fall again. This happens both on leaves that are still sepia brown as well as leaves that are starting to turn green and dark green. Affected leaves will initially develop necrosis and become spots. With further attacks, the leaves start to turn yellow and fall.

This leaf fall disease is caused by fungi, including *Pestalotiopsis* sp, *Oidium* heveae, (Kusdiana, *et al*, 2020). *Colletotrichum gloeosporioides* (Kusdiana *et al*., 2018; Cao *et al*., 2019), *Corynespora cassiicola* (Nurhayati & Situmorang, 2008), *Fusicoccum* sp. (Yosephine *et al*., 2020). Based on the symptoms detected, all of these pathogens were found in all observed smallholder rubber plantation locations. All of these pathogens spread through the air, especially in dry conditions, but disease occurs more often in humid conditions. Humid conditions are closely related to periods of dew and wet leaves necessary for spore germination. Airborne spores reach quite long distances. Passive dispersal of spores generally occurs with the help of wind. Windy rain is very suitable for the spread of disease because rain creates moist conditions which are very necessary for the spores to germinate. The germinated spores form a germ tube, appressorium, and penetrate into the leaf tissue. The next pathogenesis process is the formation of symptoms. Symptomatic leaves cause leaf fall. There is a strong correlation between an increase in the attacks of Pestalotiopsis leaf fall and a decrease in latex production (Alchemi and Jamin, 2022). The results of research by Damiri et al., 2022 showed that in rubber plants attacked by leaf fall disease the reduction in production ranged from 20% in the RRIC 100 clone to 50% in the GT-1 clone.The results of interviews with farmers in Rokam Raya village, Wanaraya subdistrict, latex production decreased by 60%, and the presence of leaf fall disease made some planters replace their crops with oil palm.

In 2019, the area of attack of this disease in Indonesia reached 382,000 hectares in the regions of North Sumatra, West Sumatra, Riau, Jambi, South Sumatra, Bangka Belitung, Bengkulu, Lampung, West Java, Central Java, South Kalimantan, West Kalimantan and Central Sulawesi (Central Rubber Research, 2023). The cause of leaf fall disease which spreads through the air occurs in all locations in Barito Kuala Regency. For diseases that spread through the air, the inoculum that reaches the leaf surface is the primary inoculum and this will be supplemented with secondary inoculum that comes next so that the rate of disease development will be higher. The high rate of development of this disease will make it difficult to control. According to Filho *et al*. (2016) control by reducing the initial inoculum only delays the epidemic if the amount of inoculum cannot be reduced to the lowest level. So in integrated disease control it is necessary to provide complete protection by combining various control techniques. The severity of rubber leaf fall disease in Barito

Kuala district ranges from 48% in Gandaria village, Anjir Pasar subdistrict, to 82% in Kolam Kiri Dalam village, Barambai subdistrict. The severity of the disease is determined by host, pathogen and environmental factors. The severity of the disease depends on the rubber clone as the host. The results of research by Damiri *et al*., (2022) show that the rubber clones PB 260 and PB 340 were attacked quite badly by leaf fall disease, namely 61.47% and 67.39% respectively, but at the same time and location RRIC 100 and IRR 112 were only attacked light, 12.61% and 19.39% respectively. The influencing environmental factor is rainfall. Rainfall patterns and rainy days influence plant canopy growth and the development of Corynespora leaf fall disease (Nurhayati & Situmorang, 2008). Availability of nutrients is an environmental factor that can influence disease severity. The element potassium is closely related to the severity of this rubber leaf fall disease. The addition of potassium will reduce the incidence of the disease. On the other hand, nitrogen has a negative correlation, so adding nitrogen will worsen disease attacks (Kusdiana *et al*., 2021).

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CONCLUSSION

1 The results of the research show that Rubber leaf fall disease has spread in four rubber plantation sub-districts. All sub-districts surveyed were 100% affected by rubber leaf fall disease. The severity of leaf fall disease in the tidal swamplands of Barito Kuala Regency is quite severe on average, namely 65%. The severity at each location varied from 48% in Gandaria village, Anjir Pasar District to 82% in Kolam Kiri Dalam village, Barambai District. In Barambai subdistrict the average disease severity is 70%, in Wanaraya subdistrict it is also almost the same, namely 71%. In Marabahan sub-district it is lower, namely 66%. The lowest sub-district is Anjir Pasar sub-district, which is only 52%.

ACKNOWLEGEMENT

The authors are grateful to Lambung Mangkurat University for the financial support under the Dosen Wajib Meneliti 2023 Program to embark on this research.

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