



## SEVERITY ANALYSIS OF FRUIT PLANT DISEASES BASED ON LEAF SYMPTOMS USING IMAGEJ SOFTWARE

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### ABSTRACT

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*Diseases in plants are abnormal and detrimental physiological processes plants. Plant organs commonly affected by the disease are leaves, roots, fruit, and stems. Diseases in plants can generally be caused by bacteria, fungi, viruses, and algae that cause diplodia, red rust patches/spots, scabies, and downy mildew. This study aims to determine the severity of disease in fruit plants using ImageJ and plantix. Based on the results of the study, found five types of fruit plants were used, namely grape vines (*Vitis vinifera*), sapodilla (*Manilkara zapota*), mango (*Mangifera indica*), rambutan (*Nephelium sp.*), and lime plants (*Citrus aurantifolia*) with different severity of plant diseases. The highest severity of the disease was found in rambutan leaves (43.73%) caused by fungi, and the lowest severity was found in lime leaves (16.12%) caused by fungi.*

## INTRODUCTION

Diseases are abnormal and detrimental physiological processes in plants. Plant diseases develop naturally due to interactions between pathogens, host plants, and the environment, referred to as the disease triangle. The most frequently infected plant organs are the leaves, roots, fruit, and stem. A plant is healthy if each organ performs its physiological functions properly. The leaf is one of the most vital organs and parts of plants. If the leaves are infected, it can jeopardize the plant's life. Some diseases found on mango leaves, lime leaves, grape leaves, rambutan leaves, and sapodilla leaves (Bambang *et al.*, 2019).

Grape (*V. vinifera*) is cultivated plant since 4,000 BC in the Middle East. Grapes are fruit plants in the form of vines belonging to the Vitaceae family. The fruit of the grape plant contains a lot of polyphenolic compounds and resveratrol which play an

active role in various body metabolisms and is able to prevent the formation of cancer cells and various other diseases. In addition, there are also secondary metabolites in grapes that can act as antioxidant compounds that are able to ward off free radicals in the body (PYD *et al.*, 2012).

Sapodilla (*M. zapota*) is a member of the Sapotaceae family originating from Central America and Mexico. Sapodilla is a tropical plant that is easy to adapt so it is widely cultivated in various countries. Sapodilla leaves are traditionally used as an anti-diarrhea medicine because the tannin compounds can inhibit and kill many bacteria such as *Shigella*, *Salmonella typhi*, and *Escherichia coli*. Sapodilla leaves also contain other active substances such as saponins and flavonoids (Mufti *et al.*, 2017).

Mango (*M. indica*) is a fruit plant originating from tropics and subtropics, especially in Asia. The mango plant can be used as a drug to lower blood glucose levels contained in the shoots of mango leaves (*M. indica*). Mango is a tropical fruit in the Anacardiaceae family. Mango leaves contain pharmacological properties, namely mangiferin which is efficacious as an antidiabetic substance or lowering blood glucose levels. Mangiferin is a glycosyl xanthone type polyphenol. Mangiferin can also be used as a natural product for analgesic, antidiabetic, antisclerotic, antimicrobial, antiviral, cardiac, hepatoprotective, antiallergic, monoamine oxygenase (MAO) inhibitors, and protection against UV radiation (Risda, 2018).

Rambutan (*Nephelium* sp.) is an annual fruit tree in the Sapindaceae family. Rambutan has an attractive round, yellowish red, or bright red fruit shape and color, as well as a high nutritional content, particularly vitamin C. Rambutan is also frequently attacked by diseases, which result in the loss of flowers and fruit, as well as the death of the plant. Rambutan fruit can be used as an anti-diabetic drug in the seeds, the stem can be used as a cancer treatment, the leaves can be used as an anti-diarrhea and the roots can be used to reduce fever (Pratiwi, 2015).

Lime (*C. aurantifolia*) is a small tree with dense but irregular branching that grows to a height of 1.5 to 5 meters. Lime leaves are alternately arranged and range in shape from oblong to round, with a rounded base and blunt leaf tips. The leaves contain a high concentration of bioactive compounds that inhibit bacterial growth, but lime plants cannot be completely isolated from pests and diseases. Anthracnose is one of the diseases that affect lime plants with the brown spots on the leaves (Puspito *et al.*, 2018).

Therefore, this study aims to determine the symptoms of the disease and the severity of grape leaves, sapodilla leaves, mango leaves, rambutan leaves, and lime leaves on fruit trees.

## **MATERIALS AND METHODS**

### ***Materials***

The materials and tools used in this study were stationery, camera (mobile phone Oppo A12 Android 9.0 (Pie), ColorOS 6.1), laptop (ASUS A456UR Intel Core i5), clear plastic 12 x 25 cm (2 kg), grape vines (*G. vitis*), sapodilla (*M. zapota*), mango (*M. indica*), rambutan (*Nephelium* sp.) and lime plants (*C. aurantifolia*). ImageJ Version 1.8.0\_172 (National Institute of Health, Bethesda, MD, USA) (NIH, 2022) and Plantix application version 3.7.3 (Taiwan).

### ***Methods***

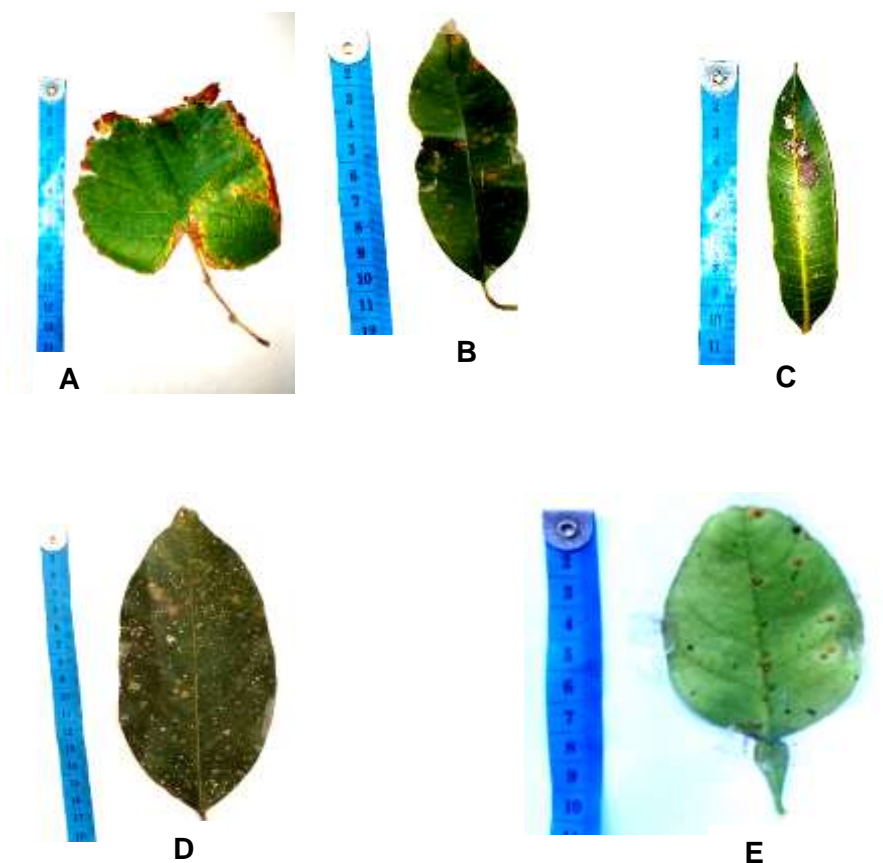
This research was conducted in Samarinda (Jl. Bayur and Jl. Pada Elo) for Sapodilla leaf (*Manilkara zapota*), Rambutan leaf (*Nephelium* sp.), Lime leaf (*Citrus aurantifolia*) and in Bontang (Jl. Nanas) for Grape leaf (*Genus vitis*) and Mango leaf (*Mangiferae indica*) using the plant severity identification application, ImageJ Version 1.8.0\_172 (National Institute of Health, Bethesda, MD, USA) (NIH, 2022)..

Measurement of the severity of disease symptoms on leaves was done by preparing a leaf image that shows the entire leaf surface with a ruler as a calibrator, opening ImageJ software. The calibration was performed before the measurement of leaf was conducted. The scale was determined in cm. The area of leaves was selected to know the severity width area. The percentage of severity was calculated in Microsoft Excel and repeated at least 3 leaves for each plant. The number of lesions and symptom diameters were calculated. The results were analyzed in Microsoft Excel and presented as figures and tables.

## **RESULTS AND DISCUSSION**

The leaves used in the disease identification study consisted of 5 leaves of fruit plants. Leaves of fruit trees include mango leaves (*M. indica*), sapodilla leaves (*M.*

zapota), rambutan leaves (*Nephelium* sp.), grape leaves (*V. vinifera*), and lime leaves (*C. aurantifolia*) (**Figure 1**). Leaves infected with this disease develop yellow and black spots.



**Figure 1.** Leaves that have symptoms in the case study include, Grape leaf (*V. vinifera*) (A); Sapodilla leaf (*M. zapota*) (B); Mango leaf (*M. indica*) (C); Rambutan leaf (*Nephelium* sp.) (D); Lime leaf (*C. aurantifolia*) (E)

Disease symptoms on the leaves of fruit plants were analyzed using the Plantix application (**Table 1**). Plantix provides users the data to analyzed the types of diseases, its causes and how to cure it (Rosadi *et al.*, 2022). There were 5 types of food plants studied, and it was found that, on average, leaf disease was caused by 4 types of fungi and 1 type caused by algae parasites. Based on data from Plantix, the causes of diseases in grape leaves, sapodilla leaves, mango leaves, rambutan leaves, and lime leaves, respectively, showed symptoms of disease caused by downy mildew, fungus, bacteria, and citrus scabies.

**Table 1.** Symptoms of food plant leaf disease

No.	Sample	Symptoms	Cause
1.	Grape leaves	Yellowish-green oily spots with brownish margins on leaves. There are white to gray hairs under the spots. Stunted growth.	Fungi
2.	Sapodilla leaves	Rounded light brown spots on the leaves. The spots are clear, dry, brown to black, with a diameter of about 1.5 mm on the leaves. The growing spore mass is brown to black, but it turns pink to yellowish in moist conditions.	Fungi
3.	Mango leaves	Black watery spots on the leaves. Leaf loss occurs prematurely. Small black spots then turn into craters that secrete sap on the fruit.	Fungi
4.	Rambutan leaves	Hairy green to orange spots on leaves. There are cracks in the bark of young stems. There is leaf loss (defoliation), fruit shape changes, and an infection on low hanging branches.	The algal parasite <i>C. virescens</i>
5.	Lime leaves	Yellowish or brightly colored nodules on both sides of the leaf. Affected leaves will curl or shrivel with rough edges. Solid and yellowish or gray scabies that resembles a wart.	Fungi

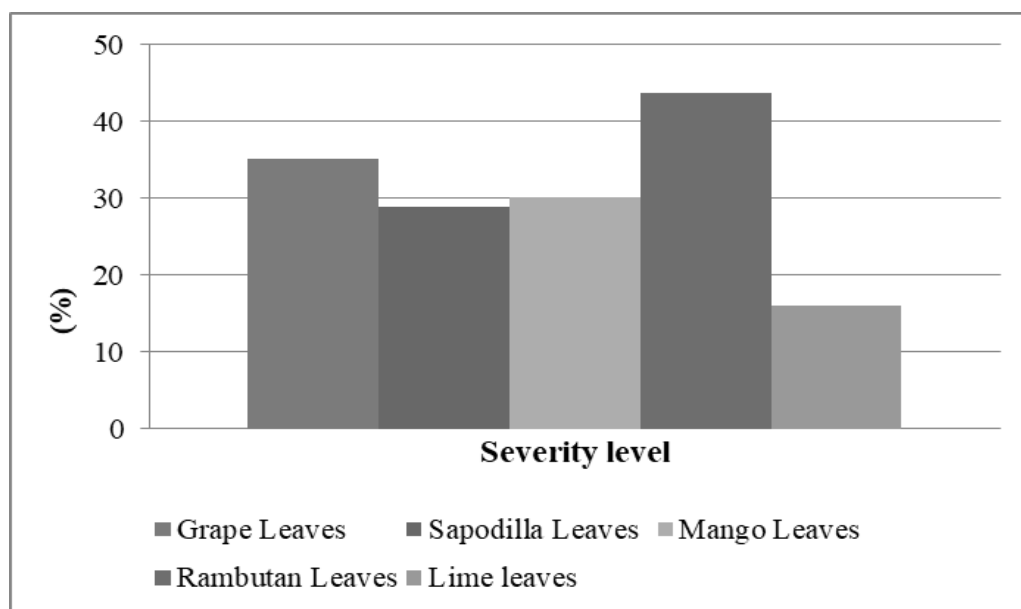
**Table 2.** The area and area of disease in the leaves of food crops

No	Sample	A (cm <sup>2</sup> ) (Mean ± SD)	AD (cm <sup>2</sup> ) (Mean ± SD)
1.	Grape Leaves	66,11 ± 6,57	22,67 ± 7,91
2.	Sapodilla Leaves	23,10 ± 4,84	6,73 ± 2,82
3.	Mango Leaves	28,60 ± 2,56	8,84 ± 4,96
4.	Rambutan Leaves	89,32 ± 17,92	42, 51 ± 35,60
5.	Lime Leaves	25,20 ± 1,92	4,19 ± 2,10

**Explanation:** A = Area of Leaves, AD = Area of Diseases

Based on the case study, the area and area of disease in the leaves of food crops were obtained (**Table 2**). Rambutan leaves showed the highest disease area (42, 51 cm<sup>2</sup>). The leaf area of the plant with the area of the disease could affect the severity of the leaves of food crops. The study results indicate the severity of the leaves of food

plants (**Figure 2**). Rambutan leaves (43.73%) obtained a high severity level compared to 4 other types of plants. The severity of grape leaves (35.12 %), sapodilla leaves (28.87%), mango leaves (30.11 %), rambutan leaves (43.73%) and lime leaves (16.12 %).



**Figure 2.** The severity of disease in food crops

### **Rambutan leaves (*Nephelium* sp.)**

Rambutan leaves infected with *C. virescens* algae displayed round spots that were slightly swollen, green to orange, and measured 2-4 mm in diameter. Leaf spot typically occurs during periods of high temperatures and rainfall, and thus targets plants with slow growth. According to (Bambang *et al.*, 2019), disease symptoms on plant leaves include leaf spots that appear as stains or small spreading spots and slightly thickened, yellow-brown spots caused by the fungi *Pestalotia* sp. and *Cercospora* sp.

### **Lime leaves (*C. aurantifolia*)**

Diseases of lime leaves produced yellowish or brightly colored nodules on both sides of the leaves. The nodule would develop into an irregular cone with a brownish top as the disease progresses, eventually covering the majority of the lamina. The nodules on the fruit were slightly swollen and pale brown. When the nodule is mature, it develops into a dense wart-like scab that would eventually turn yellowish-brown or

gray. According to (Sembiring *et al.*, 2021), symptoms of this disease include disease on plant leaves in the form of scurvy, which results in scabs developing on the fruit's skin. Scabies symptoms include brown to gray spots resembling splashes of hard and rough water to the touch.

#### **Grape leaves (*V. vinifera*)**

The grape's leaves exhibited disease symptoms in the form of yellowish-green oily spots with brownish margins on the leaves and white to gray hairs beneath the spots caused by fungi. This is consistent with (Priyotamtama *et al.*, 2015) opinion, which stated that the disease manifests itself in almost all grape vines by causing the leaves to appear yellow on young leaves and brown on older leaves. This is a symptom of powdery mildew disease caused by a fungus that grows in moist air.

#### **Sapodilla leaves (*M. zapota*)**

The sapodilla plant's leaves showed disease symptoms such as stunted growth, rounded light brown spots, and clear, dry, brown to black spots with a diameter of about 1.5 mm on the leaves, where fungi were responsible for this symptom. This is consistent with (Widiastuti *et al.*, 2015), who states that the disease manifests itself on the leaves of the sapodilla plant as spots or a change in color to black, which can eventually result in the sapodilla plant's growth being inhibited. This symptom is caused by one or more fungi, specifically *Lasiodiplodia* and *Pestalotia*.

#### **Mango Leaves (*M. indica*)**

Mango leaves displayed symptoms such as black watery spots on the leaves, premature leaf loss, and small black spots on the fruit that developed into craters that secrete sap. According to (Solikin, 2020), the disease's symptoms were black, velvet-like spots on the leaves of the mango plant caused by the fungus *Diplodia* sp., which lives in sweet liquids and typically attacks plants' roots, stems, bark, fruit, and leaves.

### **CONCLUSION**

According to the research, there are five types of food plants with varying degrees of severity of plant diseases, such as rambutan leaves (43.73%), which are caused by fungi and are the most severe. The severity of fungi-caused damage to grape leaves is

35.12%, to sapodilla leaves is 28.87%, and to mango leaves is 30.11 %. The severity in rambutan leaves is 43,73%, caused by the algae parasite *C. Virescens*. The severity of disease in lime leaves is 16.12 %, caused by fungi.

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