

# Measurement Of Leaf Spot Disease On *Alternanthera Sessilis* In Rice Fields At Devarapalli Mandal, West Godavari District, Andhra Pradesh, India.

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## Abstract

*Alternanthera sessilis* often known as joy weed. It belongs to the family Amaranthaceae; is one of the most predominant diseased weeds in rice fields of Devarapalli mandal West Godavari district, Andhra Pradesh. The symptoms of this disease appear as reddish pink color circular spots on the leaves. The disease severity is maximum in the month of August during kharif season. This study is mainly concerned about measurement of disease severity using visual analysis, Image J (IJ), and Leaf doctor (LD) applications. Each diseased leaf of the plant was exposed to visual assessment, Image J (IJ), and Leaf Doctor (LD) applications. The data was subjected to statistical analysis. This study indicates Leaf Doctor (LD) application is accurate, easier, and faster whereas determination of diseased leaf area with Image J (IJ) application is most suitable.

**Keywords:** plant disease assessment, reliability, disease severity, quantification, disease severity, standard deviation, evaluation

## INTRODUCTION: -

Paddy is one of the most important staple foods that are grown in Devarapalli mandal West Godavari district, Andhra Pradesh. Weeds are becoming more prevalent in paddy fields. A Weed is a "plant growing where it is not desired" (Klingman and Noordhoff, 1961). Many fungal pathogens infest the weed plants in rice fields. *Alternanthera sessilis* an erect annual herb is the predominant diseased weed in the study area. Fungi that cause disease on this plant first appear as reddish pink spots on the leaves, then as holes. In case of severe infection, the entire leaf is covered with spots and sometimes it turns into yellow in colour.

Measuring disease severity is useful for determining pervasiveness and extent of damage caused by a disease. It also describes how much the pathogen is impacting the host plant. Disease on plant can be quantifiable in terms of intensity. The word "disease intensity" refers to the amount of disease present, commonly expressed as either disease incidence (a portion of the total number of affected plants) or disease severity (proportion of total plant area that is infected) (James W.C et al. 1979). Measurement of plant disease intensity (the proportion of disease in a population, (Nutter Jr et al. 1991) is measuring epidemics in experiments or surveys, assessing yield loss, comparing phenotypes for disease resistance, and studying the impact of treatments (chemical, biological, agronomic, or environmental variables) on disease seem to be some of the aspects. (James 1974; Kranz 1988; Cooke 2006; Madden et al. 2007; Bock et al. 2010a). There are various methods to quantify disease intensity, observation through naked eye is used but it does not give accurate and reliable results. This study indicates the measurement of disease severity in *Alternanthera sessilis* leaves using visual assessment, Image (IJ), and Leaf doctor (LD) applications.

The word "visual estimation" refers to the eye sensing a stimuli (such as a diseased specimen), followed by our brains' perception of the experience, which is then followed by action.

To categorize areas of the specimen as diseased, we use a cognitive process based on our training, knowledge, and skill. Basic cognition is sufficient to establish disease incidence, but more complicated cognition is necessary to make a severity estimate based on the proportion of diseased area (Bock et al. phytopathology 35:655). Visual assessment of disease is done through pictorial descriptive keys and standard area diagrams on which the plant contains disease symptoms. "Image J, is an open-source image processing program that quantify diseased area of the leaf. Image-based techniques can perform quantitative measurements that are generally more objective, accurate, and repeatable than visual scoring" (Laflamme et

al. 2016; Mutka and Bart 2015; Sibiya and Sumbwanyambe 2019; Xie et al. 2012). The Leaf Doctor is a free Smartphone app that measures the severity of plant diseases. Cornell University and the University of Hawaii at Manoa's College of Tropical Agriculture and Human Resources developed the app and used it in scientific studies. (Pethybridge et al. 2015). Despite there being multiple recent applications to quantify the disease severity, this is the first study we've come across that evaluates the severity of diseased weed in rice fields, using Image J and Leaf Doctor applications.

## MATERIAL AND METHODS: -

Samples of infected leaves with leaf spot disease of *Alternanthera sessilis* were randomly collected in rice fields of Devarapalli Mandal West Godavari district, Andhra Pradesh. Leaves that are highly infected were shot with Sony Cyber shot DSC-WX220/B 18.2MP Digital Camera. Each picture of leaf was taken twice showing upper and lower side with leafspots. The images that are captured in field are taken in day light without flash and not in a bright sunlight. This is beneficial because it reduces the amount of light reflected from surfaces of leaf that may alter natural hues of the cuticle and make disease detection process more difficult. Reflected light can make image analysis difficult on leaves with thick and polished cuticles because it makes the user difficult to distinguish the colors that are associated with diseased and healthy portions of the leaves. All the images of diseased leaves were subjected to visual assessment, Image J (IJ), and Leaf doctor (LD) applications. Statistical studies were performed on the findings of each experiment to determine their reliability and accuracy.

Statistical analysis was done through IBM SPSS, Ver.28

### Visual assessment

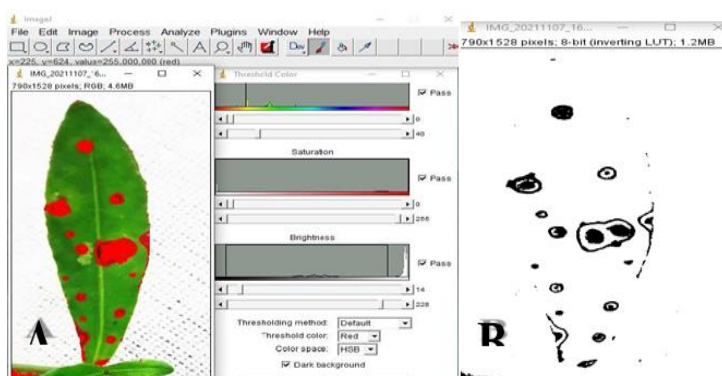
Visual assessment methods based on descriptive keys and standard area diagrams. "The leaves were classified visually into five categories in light of their disease severity rates, according to a disease severity index consisting of five categories (Sharma S R et. al 1994)

- 1= 1-10% Disease Damage
- 2= 11-20% Disease Damage
- 3= 21-40 % Disease Damage
- 4= 41-60% Disease Damage
- 5= > 60 %"

According to the Weber-Fechner rule of human acuity, the human eye is a photocell that reads in logarithms and reads the quantity of diseased tissue below 50% and a percentage of healthy tissue more than 50% (Horsfall and Barratt; 1945). Visual assessments were done based on the Horsfall and Barratt scales for disease severity.

### Image J (IJ)

Image J 1.46 (an open-source software (National Institute of Health, USA, [http:// image J. NIH.Gov/I](http://imagej.nih.gov/)) is used to analyze image-based measurements that generate statistical results more accurate and precise than subjective observation or rating. By using a single image, Image J can measure many measurements such as diseased leaf area, number of leaf spots, and so on. All the photos of infected leaves have taken with high contrast backdrop so that the leaf can be distinguished from the background and the leaf area can be measured. Set scale is to be done for the calibration of the image. For the area measurement of the leaf, color threshold parameters (hue, saturation, and brightness) are adjusted for both disease and healthy portions of the leaf. Color threshold parameters are adjusted to separate leaf from the background to calculate entire leaf area and it is also adjusted to separate leaf spots from the healthy area of the leaf in order to assess diseased area. Later the color image is converted to binary image. For disease assessment, after converting into binary image we can erase the parts that are not associated with disease. This helps to calculate exact lesions of the diseased leaf, represented in fig.1.



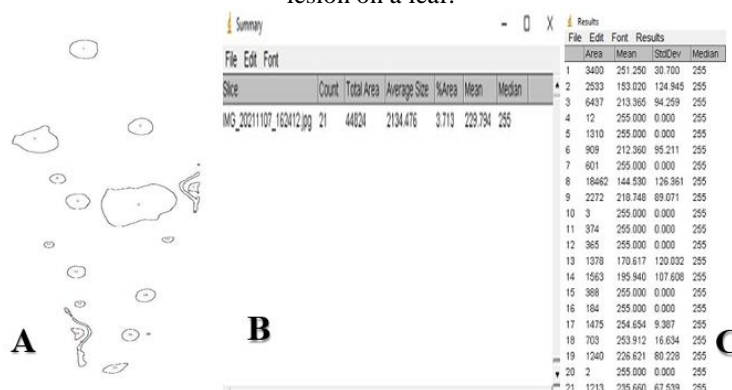
**Fig.1.** (A) Adjusting color threshold parameters to separate diseased spots from leaf. (B) Binary image showing disease spots.

The proportion of infection harm is calculated as  $\text{infected leaf area} \div \text{total leaf area} \times 100$ .

For multiple plants assessment Image (J) allows to measure entire canopy area and diseased canopy area. This type of

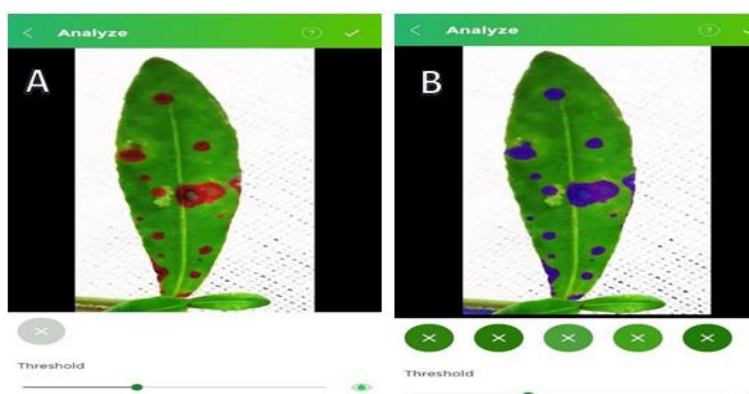
measurement is used to calculate disease percentage on entire plant. The percentage of disease damage for it is calculated as  $\text{Diseased canopy area} \div \text{Entire canopy area} \times 100$ . Image (J) is an advantage as it can assess each lesion of the diseased leaf along with the total count of lesions. The binary image is analyzed for particles to measure the number of lesions on the leaf, total area, average size, percentage of area. Each lesion area is also measured, (fig.2)

**Fig.2.** (A). Drawings of each lesion denoted with numbers. (B). Assessment of lesions a leaf. (C). Assessment of each lesion on a leaf.



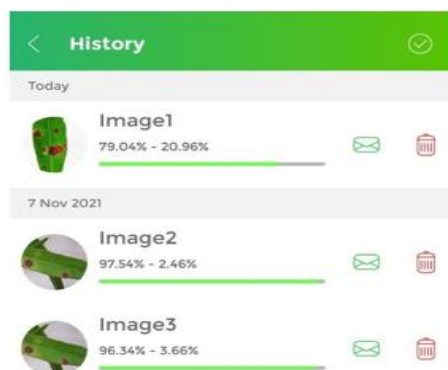
### Leaf doctor (LD)

Leaf doctor (LD) is downloaded from the play store in smart phone. The instructions are provided on the “About” option in the app. All the images that are used in this app requires solid black background only. For assessment of the leaf the healthy area has to be touched with fingers. This indicates the color of the healthy tissue. Different colors are selected to symbolize healthy tissue by touching consecutive parts of the photograph. Maximum of eight colors can be used. In this study five hues on surface of the leaf are selected to symbolise healthy tissue is denoted in fig3.



**Fig.3.** (A) *Altermanthera sessilis* leaf spot using Leaf doctor app, selected five colors to represent healthy tissue. (B) Threshold slider bar showing maximum differentiation between healthy (green color) and diseased (blue color) portions.

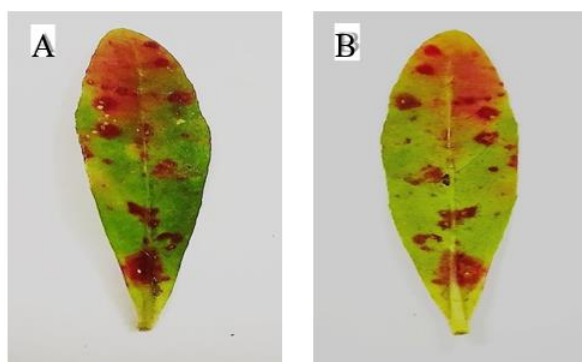
After removing black background, the system considers the hue from every pixel of an image to the preset healthy hues and determines whether it is healthy or diseased. Using the threshold slider bar, the maximum distance of the healthy color is modified and the healthy leaf is made in green color and the diseased portions are in blue color. Finally, it is analyzed to calculate the percentages of disease and healthy areas. The percentages that are given by Leafdoctor app are noted in fig.4.



**Fig.4.** Severity of the leaf spot analyzed by Leaf doctor app. Percentage represent the healthy and diseased portions of the leaf.

**RESULTS AND DISCUSSIONS: -**

The samples of *Alternanthera sessilis* leaves showing the symptoms of leaf spot disease, upper and lower sides respectively are indicated in fig.5.



**Fig.5.** (A.) Symptoms showing on upper view of the diseased leaf (B). Symptoms showing on lower view of the diseased leaf.






The lesions on the leaf are isolated, observed under microscope and tested its pathogenicity. The disease severity of five different leaves with variation in severity levels had been calculated using visual assessment, Image (IJ), and Leaf doctor (LD) applications. Percentages of diseased leaves are reported in table.1.

METHOD OF ASSESSMENTS	DISEASED LEAVES OF <i>Alternanthera sessilis</i>				
<b>IMAGE (IJ)</b>					
<b>Diseased percentage</b>	21.9%	23.5%	36.7%	52.5%	94.3%
<b>LEAF DOCTOR</b>					
<b>Diseased percentage</b>	22.1%	27%	36%	50.3%	86%
<b>VISUAL ASSESSMENT</b>					
<b>Diseased percentage</b>	10%	30%	50%	60%	80%

**Table.1.** Assessment of disease percentage through Image (IJ), and Leaf doctor (LD) and Visual analysis of the same leaves with different extents of infection severity of *Alternanthera sessilis* leaf spot disease.

Percentage of diseased area calculation through Image (IJ), and Leaf doctor (LD) shows numerical variations. In Image (IJ) the diseased portions are separated from the healthy leaf with color threshold, and the red color is used to represent it; on the other hand, Leaf doctor (LD) is represented as blue in color. The percentage of disease damage is 94% and lowest is 10%. Number of lesions for each leaf, average size of lesions, mean, median, standard deviation, total area of entire leaf and diseased leaf a assessed by Image (IJ) software.

They are provided in table.2.

Leaf assessed	Area of entire leaf (in CMS)	Area of diseased portions (in CMS)	Number of lesions	Average size of lesion	% Of disease damage	Mean	Median	Standard deviation
	19.576	4.292	3	1.431	21	255.0	255	0
	22.757	5.359	14	0.383	23	254.3	255	0
	16.832	6.178	18	0.686	36	253.3	255	0
	24.979	13.121	22	2.624	52	254.5	255	0
	19.037	17.970	42	17.970	94	232.5	255	0

**Table.2.** Determination of different variables of *Alternanthera sessilis* leaf spot disease with Image (IJ) software.

Area of entire leaf and area of diseased portions are used to determine the percentage of damage due to disease. Among five leaves of different severity levels the highest percentage of damage is 94% with 42 lesions. All the statistical data was analyzed with SPSS software.

## CONCLUSION

Determination of diseased through leaf Image (IJ), and Leaf doctor (LD) provides accurate, reliable results. Assessment through Leaf doctor (LD) app is easier and can get quick results, when compared to Image (IJ). Leaf doctor (LD) app assesses both healthy and diseased leaf area percentage at a time for a single image. Image (IJ) is a time-consuming technique for determining diseased value, although it not only provides diseased percentage but also aids in the calculation of mean, median, and standard deviation. The best feature of Image (IJ) is, it allows to assessing number of lesions per leaf and area of each diseased lesion. *Alternanthera sessilis* leaf spot disease is assessed to know the impact of pathogen on the plant. These studies are further used to study host specific interactions of the plant.

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