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## MEASUREMENT OF LEAF AREA: A NEW APPROACH

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**Abstract:** In a research of identifying and diagnosing plant diseases, the patterns that appeared on the leaf are considered as important concept in detection of these diseases occurred because of nutrient deficiencies in the plant. The various features of image of leaf are extracted such as the shape of leaf, area of leaf, shape of holes present on the leaf, disease spots etc. These features could be extracted using different image processing techniques. The feature extraction is the key point of this work. These extracted features are used to determine the occurrence of the particular deficiency related to primary nutrients of cotton plant. Improper use of pesticide for plant diseases treatment increases the cost and environmental pollution so their use must be appropriate. This can be achieved by targeting the nutrient deficiency using image processing technique.

**Keywords:** Cotton, Deficiency, Leaf Area, Image Processing



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## INTRODUCTION

As India is an agricultural country and 70% of the population depends on agriculture. Observers have wide range of diversity to select particular fruit and vegetable crop for optimum throughput. However the cultivation of these crops for optimum yield and quality product is highly technical. It can be further increased by the aid of technological support. The world textile industries are being ruled by "Cotton King" and India is recognized as cradle of cotton industry. India thus enjoys the distinction of being the earliest country in the world to domesticate cotton and utilize its fiber to manufacture the fabric. Maharashtra is the important cotton growing state in India with 31.33 lacks hectars area and production of approximate 62 lack bales. The second largest producer of cotton in the world, about 3 million observers is engaged in cotton cultivation in the state mostly in backward region of Marathwada and Vidarbha.<sup>[1]</sup>

Generally the visual observation of the pattern appearing on the leaf of plant, the observer used to decide which fertilizer to be used but no idea how much? Hence sometimes wastage of money and overdose of fertilizer may disturb the life cycle of plant as well as surrounding. The cotton leaf mainly suffers from the diseases like foliar leaf spot of cotton, fungus, viral diseases. About 80% to 90% of diseases reflect the symptoms on the leaves of cotton plant. Hence we are focusing on the pattern changes in the leaf of cotton. These diseases mainly occurs due to the deficiency of nutrients<sup>[1]</sup>.The image processing now a day's become the key technique for the diagnosis of various features of the crop, providing new approach to explore the field of agriculture. The image processing can be used in the agricultural applications for the following purposes.<sup>[2]</sup>

1. To detect diseased leaf, stem, fruit.
2. To determine affected area by disease.
3. To find shape of affected area.
4. To determine the size and shape of fruits.

Leaf area is one of the most important features that describe the deficiency of leaf. In case of nitrogen deficiency, the cotton leaf size gets reduce than that of normal leaf hence by calculating the area of deficient leaf and comparing it with that of healthy leaf, it is possible to conclude that the leaf is nitrogen deficient. This approach is applicable for few other nutrients deficiency identification, which results the reduction in the leaf area as a symptom. The earlier approaches implemented gives the physical area measurement where as one has to consider

the age of leaf while identifying the Nutrients deficiency, the leaf is yellowish weather due to age or due to deficiency. As said above the Nitrogen deficiency shows reduction in area with pale yellowish color on leaf, so even though the leaf is yellow its physical area may be larger than healthy leaf. Hence it is requires to calculate the area based on the greenish area of leaf. This work is the fast and accurate solution to analyze the area feature variation caused due to different deficiencies in the plant of cotton by using image processing techniques.

## 2. METIERALS & METHODS

The work is implemented by using the 14MP SONY CYBERSHOT Digital camera and the MATLAB software.

### 2.1. Image Acquisition.

For the analysis we have selected the Cotton crop of AJIT brand. The leaf whose deficiency is to be determined was placed flat on the white background. The camera was held horizontally to the plane of the leaf. The distance between the camera and the leaf was neither too closed nor too far; it was adjusted such a way that the photograph was covering only background and leaf as shown in figure 2.1. Nearly 15 such photographs of cotton leafs of same plot are taken for the analysis. These images are saved in JPEG format for further processing.



Figure.2.1.Captured sample Images of Cotton Leaves.

## 3. AREA MEASUREMENT BY PLANE SEPARATION.

It's possible to calculate the area by using different approaches as when one thinks of the area the first thought comes to mind is physical dimensions of the object, but here the approach is different. The method is based on the pixel statistics. The reference coin of known diameter is use find the area of leaf. First the RGB image of coin in converted in to gray scale and then in to binary image. The unit pixel area of the reference coin is calculated from the binary image, then this area is multiplied with the pixels belongs to the leaf whose area is to be calculated. Here two different approaches are use. In first method the leaf is separated in to

three planes namely Red, Green, and Blue Plane respectively. The leaf consists of green color as a major component hence only the green components are measured using thresholding. The threshold value is obtained by trial and error technique. Once the green pixels are calculated the area can be easily calculated using the unit pixel area. The above procedure is repeated for the sample leaf. The results obtained for the sample leaf is compared with that of normal leaf to conclude the deficiency. The flow diagram for the leaf area measurement by plane separation method is as shown in figure 3.1

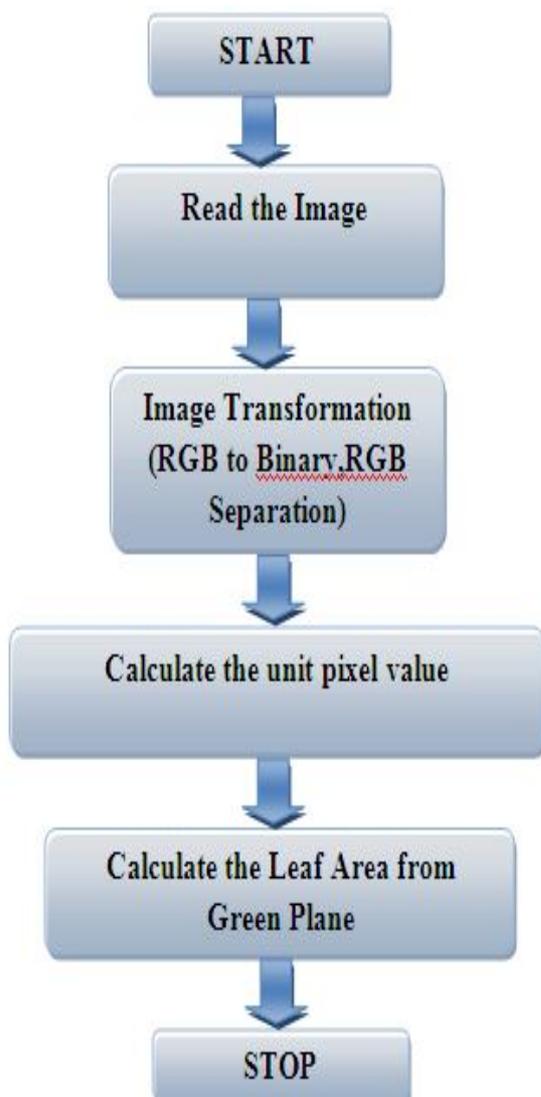


Figure. 3.1. Flow chart for measurement of leaf area by Plane separation

#### 4. RESULTS OF AREA BY PLANE SEPARATION

```
MATLAB 7.7.0 (R2008b)
File Edit Debug Parallel Desktop Window Help
Current Directory: C:\Documents and Settings\admin\Desktop
Shortcuts How to Add What's New

count of pixel in coin is
8073

unit pixel value is

Unit_pix =
6.0774e-004

count of pixel in normal leaf is
87722

Area of normal leaf is

Area_Normal =
53.3123

count of pixel in deficient leaf is
11848

Area of Deficient leaf is

Area_Deficient =
7.2005

Defferance in area is

Area_Difference =
46.1118

fx >>
```

Figure (a). Theoretical Values for Area of Healthy & Deficient Leaf

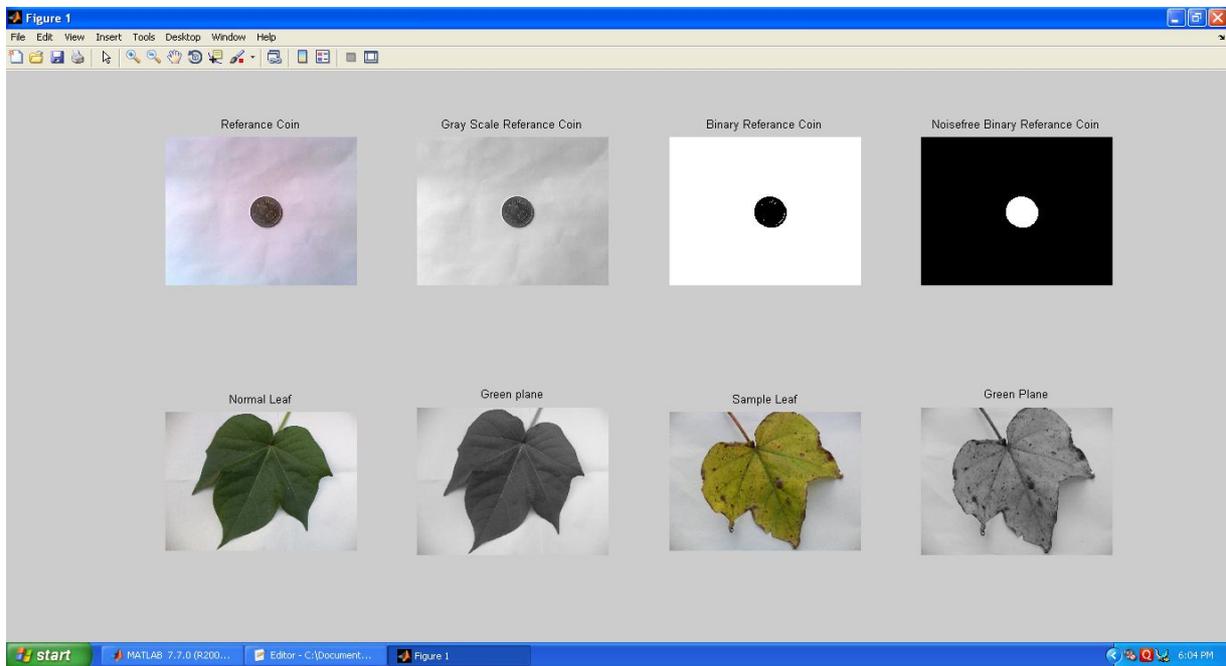


Figure (b). Resulting Images of Reference coin ,Healthy & Deficient Leaf

Figure.4.1 (a&b).Results of area measurement by Plane Separation.

## 5. AREA MEASUREMENT BY MASKING.

By using the mask of the predetermined threshold value any portion from the image can be extracted for the analysis. This method differs from the first method in the sense that first masking of leaf is done to remove the background that represents the equal values of RGB components in an image  $i: e [255,255,255]$  because of white background paper. The mask threshold value is decided by trial and error method. Then the RGB planes of resulting image are separated. Then similar to Plane separation method the green pixels are used to calculate the area of leaf. Again the unit pixel area is calculated using the reference coin image. The results obtained for the sample leaf is compared with that of normal leaf to conclude the deficiency. The flow diagram for the leaf area measurement by masking method is as shown in figure 5.1

### 5.1. Algorithm

1. Read the Image of Reference Coin.
2. Convert the RGB Image in to Grayscale Image.
3. Convert the Gray Scale Image in to Binary Image.
4. Calculate the unit pixel value from the known coin area.
5. Read the Normal leaf image.
6. Mask the background of the image
7. Separate the RGB Plane of the image.
8. Count the Green pixel from the image.
9. Compute the area of leaf using the unit pixel value.
10. Repeat the steps 5 to 9 for the sample leaf.
11. Compare the results of step 9 for Normal leaf & Deficient Leaf.

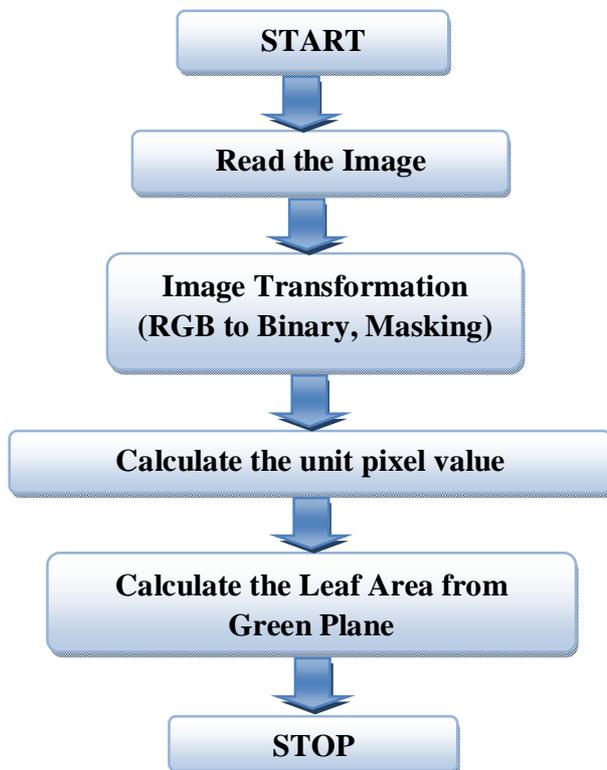


Figure. 5.1. Flow chart for measurement of leaf area by Masking

## 6. RESULTS OF AREA BY MASKING

```
MATLAB 7.7.0 (R2008b)
count of pixel in coin is
8973
unit pixel value is
hair_pix =
6.0776e-004
count of pixel in normal leaf is
87722
Area of normal leaf is
Area_Normal =
53.3123
count of pixel in deficient leaf is
11848
Area of deficient leaf is
Area_Deficient =
7.2003
Difference in area is
Area_Difference =
46.1120
```

The screenshot shows the MATLAB 7.7.0 (R2008b) command window with the following output:

Variable	Value
count of pixel in coin is	8973
unit pixel value is	6.0776e-004
hair_pix =	6.0776e-004
count of pixel in normal leaf is	87722
Area of normal leaf is	Area_Normal = 53.3123
count of pixel in deficient leaf is	11848
Area of deficient leaf is	Area_Deficient = 7.2003
Difference in area is	Area_Difference = 46.1120

Figure 6.1(a). Theroretical Values for Area of Healthy & Deficient Leaf

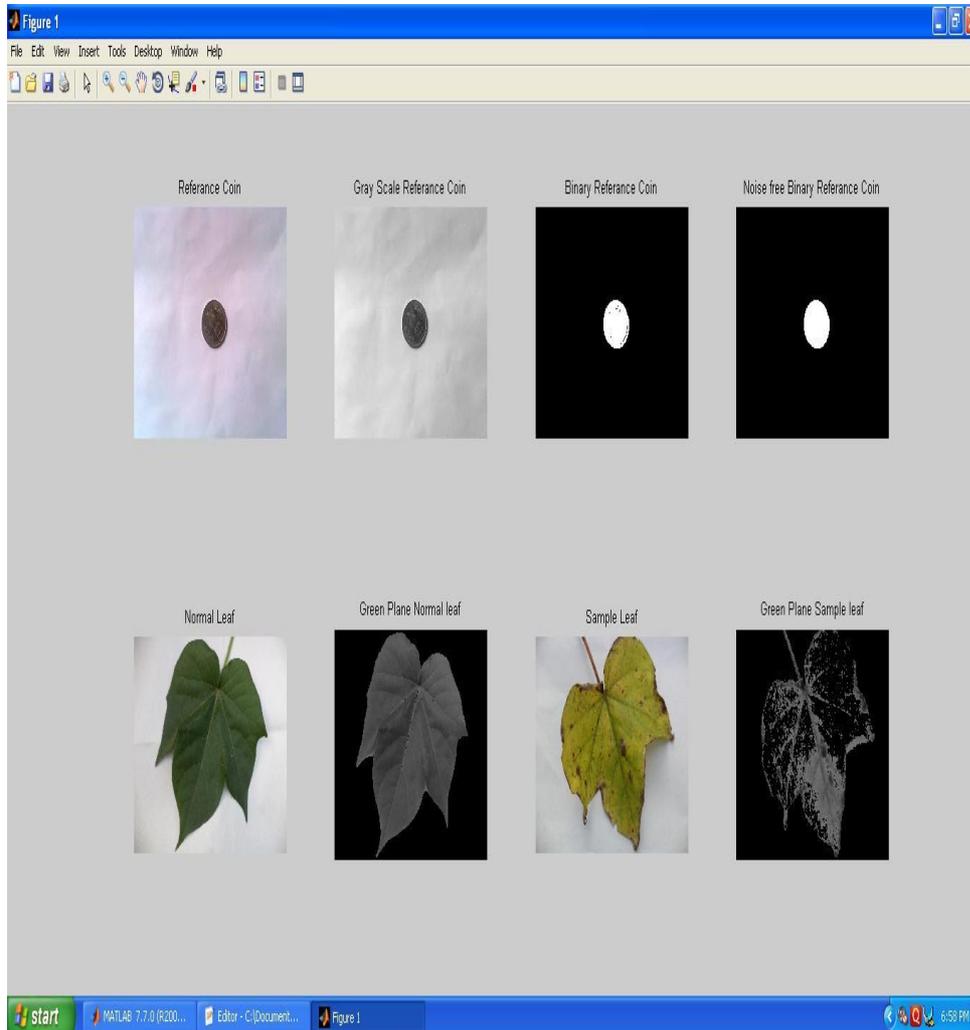


Figure 6.1(b). Resulting Images of Reference coin ,Healthy & Deficient Leaf

## 7. CONCLUSION & DISCUSSION

The results obtained by both methods are found same. By applying any one of the method one can measure the area of the leaf. Since the measurement of leaf area by considering the physical size of the leaf sometimes gives unexpected results. As the age of the leaf is also the factor that influence the size of the leaf. The above methods can be very useful for the disease spot area measurement of any leaf.

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