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IDENTIFICATION OF NITROGEN DEFICIENCY IN COTTON PLANT BY USING IMAGE PROCESSING

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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 proposed 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.

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 hectors 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. [1]

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[1].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. [2]

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.

This work proposes the fast and accurate solution to analyze the different patterns caused due to different deficiencies in the plant of cotton by using image processing techniques.

MATERIAL & METHODS

Here proposed approach for the detection of nutrient deficiency in cotton crop is by processingthe captured image through MATLAB. In this proposed method the image captured by using SONY CIBERSHOT 14 MP digital camera is preprocessed for the noise removal. Since all the nutrient deficiencies results in variations in attributes that appears on leaf. These variations in the features are measured with respect to healthy leaf. The feature extraction may involve Spectral features, spectral parameters, Geometric features and Textural features.

DETERMINATION OF NITROGEN

Nitrogen Deficiency Symptoms

There are sixteen nutrient elements required for normal growth of crop. Three basic elements Carbon (C), Hydrogen (H), and Oxygen (O2) are taken up from atmospheric carbon dioxide and water. Thirteen other nutrients are taken up from the soil and are usually grouped as Primary, Secondary, and micronutrients [3].

There are three primary nutrients. These are utilized in the largest amount for the crops, and therefore are applied at higher rates than secondary and micronutrients. Plant requires nitrogen which is one of the major of the three nutrients. It is responsible for the chlorophyll manufacture through photosynthesis. Nitrogen is usually concentrated in the growing points of the plant. Nitrogen deficiency shows following symptoms.

1. It influences both rate, and extent of growth.

2. A pale yellowish green color coupled with reduction in leaf size is the most striking symptom of nitrogen deficiency in cotton.

3. It also results in to stunted growth. Visual symptoms are seen first on older leaves as a yellowing from the leaf tip and along the midrib while the edges remain green. By considering the various parameters such as change in the size, color etc. following steps can be taken to extract the various features to detect the deficiency [4].

Image Acquisition

Nearly 25 photographs of cotton leafs of same plot are taken for the analysis as shown in figure 1. These images are saved in JPEG format for further processing [5].Nitrogen deficiency can be detected by two preliminary steps, Histogram analysis
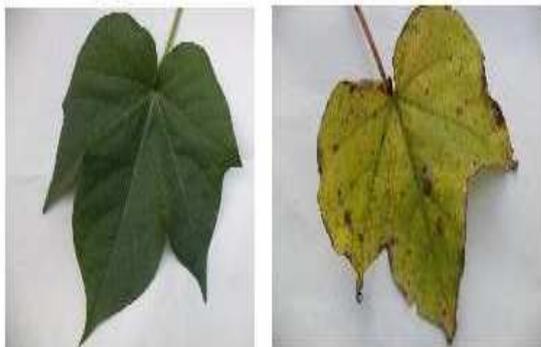
and measurement of leaf area

Figure 1. Sample cotton leaf Images

Histogram analysis

Algorithm:

1. Read the image.

2. Convert RGB to Grayscale image.

3. Plot the histogram.

The algorithm is repeated for the healthy as well as visually deficient leaf. Input RGB image of healthy leaf is first transformed in to gray scale image to plot the histogram. Same steps are carried out for plotting the histogram of deficient leaf. From the obtained histogram shown in figure 2. Following points are concluded.

1. Histogram of normal leaf is concentrated symmetrically at certain value on the gray scale.

2. Histogram of normal leaf has maximum peak occurs generally about 30% and 90% of dynamic range. This indicates frequency of occurrence of single color in leaf.

3. Histogram of deficient leaf has non symmetric shape at certain values on gray scale. Narrow downs the dynamic range than the healthy leaf.

4. Histogram of deficient leaf has smaller peak amplitude than that of normal. These peaks occurs generally about 50% and 70% of dynamic range of normal plant.

Measurement of leaf area

Leaf area is one of the most important feature that describes the deficiency of leaf [6]. In case of nitrogen deficiency, the cotton
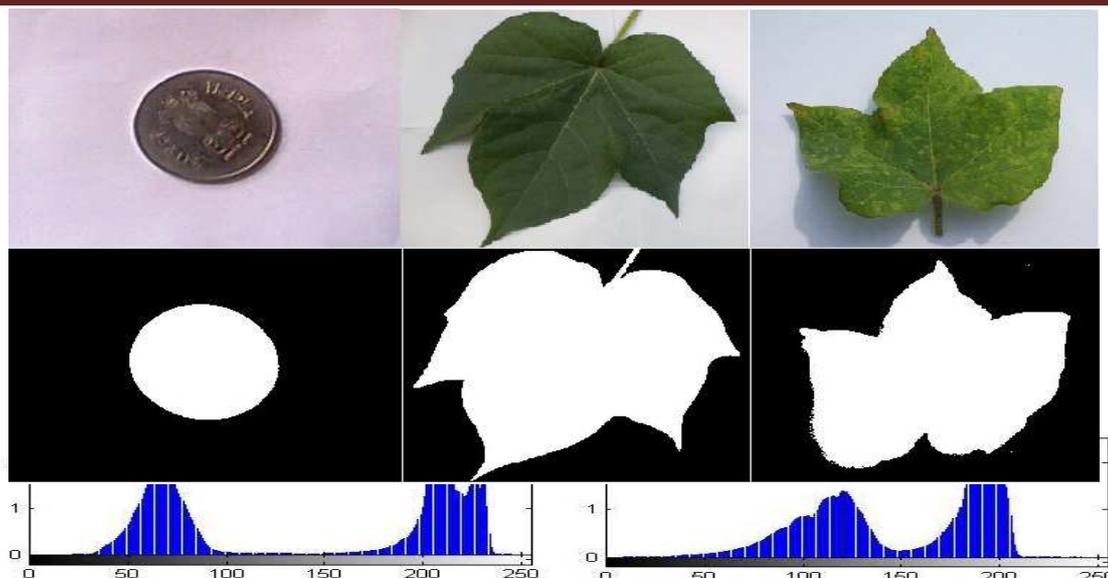
Figure 2.Histogram for Normal & Deficient leaf.

leaf size gets reduced 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 or not. The algorithm is repeated for the reference object, healthy leaf as well as visually deficient leaf.

Algorithm:

1. Read the image.

2. Convert RGB to Grayscale image.

3.ConvertGrayscale image to Binary Image.

4. Remove noise.

5. Calculate the leaf area.

Photographs captured as shown in figure 1 is processed by Matlab code in two colors. The function regionprops in Matlab is used to measure area of a selected region of an image in pixel count. Before applying the function regionprops, the actual image converted into a binary image as shown in figure.3.Regionprops instruction is used to estimate area enclosed. The area is the actual number of pixels in the selected region. Leaf area is calculated through pixel number statistic. Unit pixel in the same digital images represent the same size hence from known reference area and pixel count, unit pixel size can be calculated, so that it is easy to calculate leaf area by counting total pixel in leaf area region. The pixel count of the processed image depends

Figure 3.Original RGB images& corresponding Binary images

on the distance between the camera and the object whenthe picture is taken. Smaller the distance, the larger the pixel counts. A reference object is an object withknown area, needed to translate the pixel count to area.

Here One Rupees coin is used as reference object whose area is given as follows.

(A_{coin})= 4.9063 cm2

The pixel count $(P_{count})$of the coin from the image is 8144Hence,

Unit pixel value (U_{px}) = 0.0006024cm2.

The pixel count of the healthy leaf (P_{Hleaf}) is 5954059 pixels.

Hence,

Area of Leaf (A_{Heaf}) = 3586.98cm2.

The pixel count of the deficient leaf (P_{Dleaf}) is 1287554 pixels.

Hence,

Area of Leaf (A_{Deaf}) = 775.622cm2.

RESULTS AND DISCUSSIONS

The leaf with deficiency has reduced area compared to that of normal leaf. To test the performance of the deficiency detection

system, leaves are selected from different plots and different varieties of cotton.

It is possible to detect the deficiency of other plants like, Sugarcanes, Maize, and betel by this method. One can compare the results of area measurement with the standard methods.

REFERENCES

1. Viraj A. Gulhane, Dr. A. A. Gurjar. "Detection of Diseases on Cotton leaves and its possible Diagnosis", JIP, Volume (5), Issue (5):2011.

2. Jaymala K. Patil, Raj Kumar, "Advances in Image Processing for Detection of Plant Diseases."Journal of Advanced Bioinformatics Application and Research, Vol.2, Issue 2, June-2011, Pp135-141.

3. J. A. Silva, R. Uchida. "Essential Nutrients for plant growth: NutrientsFunctions & Deficiency symptoms",Plant nutrient management, Approachfor tropical and Subtropical Agriculture,2000

4. Hezhong Dong, Wei Tang, Zhenhuai Li. "On Potassium Deficiency in cotton Disorder, Caused and Tissue Diagnosis". Agricultural conspectus Scientifics', Vol.69 (2004) No.2-3(77-85).

5. Sanjay B Patil, Dr. S. K. Bodhe," Leaf Diseases severity measurement using Image Processing" International Journal of Engineering and Technology Vol.3(5), 2011, pp.297-301

6. Sanjay B Patil, Dr. S. K. Bodhe, "Betel Leaf Area Measurement Using Image Processing," IJCSE, Vol 3.No 7, July2011, pp.2856-2660

7. Sanjay B Patil, Dr. S. K. Bodhe, "Image processing Method to measure Sugarcane Leaf area, "JEST, Vol.3,No.8 Aug.2011

8. Enrique Rico-Garcia, Fabiola Hernandez, "Two new methods for theEstimation of leaf area using digital photography" International Journal of agriculture and Biology, ISSN Online: 1814-9596, 2009.

9. H. Al-Hiary, S. Bani Ahmad. "Fast and Accurate Detection and classification of plant diseases" IJCA (0975-8887), Volume 17-No.1 March 2011.

10. AH Prakash, SESA Khader "Nutritional and physiological disorders of Cotton" Model training course onCultivation of long staple cotton (ELS) December 2007.