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New Image Processing Technique for Automatic Detection of Nitrogen in Cotton Plant

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ABSTRACT

This paper proposes method for nitrogen estimation using color image analysis from cotton plant. In this study we developed new image processing technique to estimate nitrogen content in cotton plant. We collected images of cotton leaves with the camera and applied image processing techniques. We applied different function for estimation and find (R+B)/G gives good correlation of r=0.98 within minimum time and less cost than other methods.

Keywords: Color Image Processing, RGB Functions, Regression Analysis, Nitrogen Estimation, Cotton

I. INTRODUCTION

India is one of the developing countries in the world; one of the reasons behind this is its ruler demand. The demand of the ruler India depends entirely on the agricultural sector. If there is a good monsoon, it results in good crop yield. The productivity and the quality of cultivated crops mostly depend on natural factors like nutrients, water, etc. But to meet the food requirement of a large population, it is necessary to increase crop yield. If natural resources do not meet the requirements of the crop then it needs to be externally provided. This increases production costs. Because of this, nowadays it is seen that agriculture is not a profitable business, the reason behind this, there is a difference between the cost of production and the market value of the crop. In agriculture, some of the major expenditure is on seeds, fertilization, and pesticides. Technology can help here to reduce the production price by using novel techniques in agriculture. Fertilization is the key factor and it fulfills the nutrient requirements of crop. It is important to identify the need and managing fertilization with the help of computer. Nitrogen, Potassium and Phosphorus are the three important nutrients required to plants.

II. ROLE OF NITROGEN IN COTTON PLANT

Nitrogen is one of the most important nutrients needed by plants. It is found in the chlorophyll of the leaves and is used to transfer solar energy to carbohydrates, which provide plant energy. It also focuses on growth and productivity. Nitrogen deficiency can affect the process of photosynthesis; can reduce leaf size, number of fruiting nodes, yield, and fiber quality [1]. This can also limit the absorption of water and nutrients and cause excessive cutting.

Excess nitrogen can delay maturation, overgrowth, reduce boll storage, low fiber quality, increase pest problems and contaminate soil and surface water [7] It is therefore necessary to have automated ways to obtain Nitrogen concentrations and to detect deficiencies. There are many advanced techniques to identify N deficiencies present in the cotton plant such as digital image processing, remote sensing, and neural network processes and so on. This article reviews the techniques used to detect N deficiency in a cotton plant.

There are various methods of Nitrogen detection such as color analysis using a different color analysis model, remote sensing, and neural network etc [13]. This paper introduced the process used to detect Nitrogen deficiency in a cotton plant using color images with RGB imagery features.

III. METHODS AND MATERIALS

• **Image Acquisition**: - Cotton leaf pictures collected from different farms of Beed district from Maharashtra (India). Main stem Leafs from mid upper nodes are collected as a random sample from various fields.

Images are taken by using Sony cyber shot w830 camera of twenty megapixels with CCD device. Samples of leaf pictures are taken from 15cm height with black background and resized to 1764*768 pixels.

• **Laboratory Analysis**: - Samples containing 15 leaves are collected together and analyzed in laboratory using kjeldhl method.

• **Preprocessing**: - Interference will create a variety of noise during image detection, which will significantly affect image quality [17]. It is therefore necessary to process the image, so it is needed to preprocess the image, such as removing noise and enhancing image. Thus first step in the image processing is to remove the noise if present in the captured image, so that further operation can be performed.

The enhancement techniques like Gaussian filter, wiener, median, bar graph effort, weighted median, hybrid filters, multiscale retinex with color restoration and Lee filtering ,Homomorphic filtering unit are applied on cotton leaf photos to reinforce their rummage around for identification purpose and additionally the results unit like those unit recorded in figures one. To match noised and de-noised pictures, parameters like Peak Signal to Noise magnitude relation (PSNR), Mean sq. Error (MSE), Mean Absolute Error (MAE), MAXERR values area unit accustomed assess best answer. Mean values of those parameters calculated.

It is clear that median filter provides clear look of leaf image and removes noise [18]. Such noise reduction can be a typical preprocessing step to reinforce the results of later method. Median filtering is primarily utilized in digital image method as results of, below positive conditions; it preserves edges whereas removing noise.

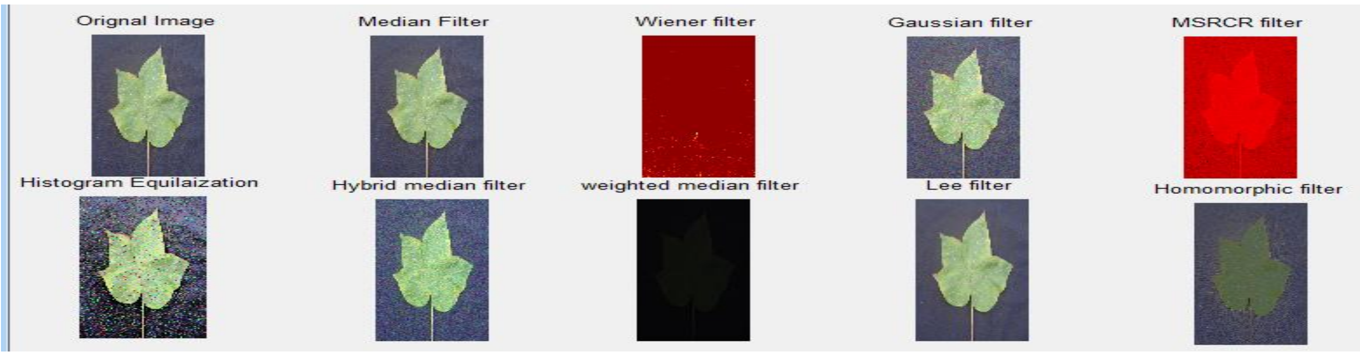


Fig. 1 filtering results

• **Segmentation**: - In this we prepared fully automatic method, in which we can segments leaf blade from dark black background and also eliminates petiole from it. This method includes two steps: first by using global threshold method, we segmented leaf blade from background and second by applying sequence of morphological operations petiole removed from leaf blade as shown in following figure 2. Experiments have been carried on 90 leaves and we got success rate of 93.33%. Compared with other methods, the pro-posed method here is simple and suitable for leaf blade segmentation [19].

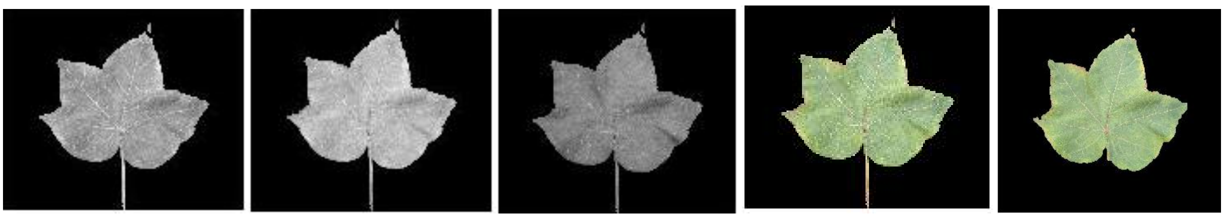


Fig. 2 (a) Masked Red Image (b) Masked Green Image (c) Masked Blue Image (d) Segmented Image (e) petiole removed image

• **Feature Extraction of Image and calculation of N :-**

Cropped images of cotton leaf blade are used for further processing. Images are separated in three different planes of R, G and B. In kjeldhal chemical analysis, we have used 15 images as one sample for N calculation; so we have calculated avg(R), avg(G) and avg(B) from15 leaf images for each sample. These normalized values of R, G and B are placed in formulas and compared.

Parameters collected from image are used to correlate with nitrogen values calculated in laboratory. The values obtained from equation and laboratory values are curve fitted to find best fitted curve with polynomial value 4. The equation (R+B)/G give more accuracy than others as shown in Table 1.

Table 1: Shows the Correlation in the Functions and Nitrogen

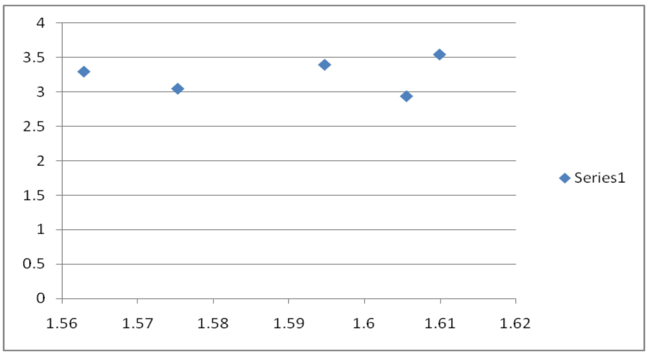
Function	**R**
(R-B)/(R+B)	0.63
2G*(R-B)/(R+B)	0.69
2R*(G-B)/(G+B)	0.65
2B/(R+G+B)	0.68
(R+G)/B	0.84
(R+2G)/B	0.93
(R-B)/G	0.920

(R+B)/G	0.98
(R-B)/(R+G+B)	0.78
(R-B)/(R+B)	0.94

Table 2: N estimation

(R+B)/G	N lab	N estimated
1.609873	3.55	3.578607798
1.562899	3.3	3.327024102
1.605502	2.94	2.968457222
1.575292	3.05	3.077434391
1.594696	3.4	3.428087652

a



b

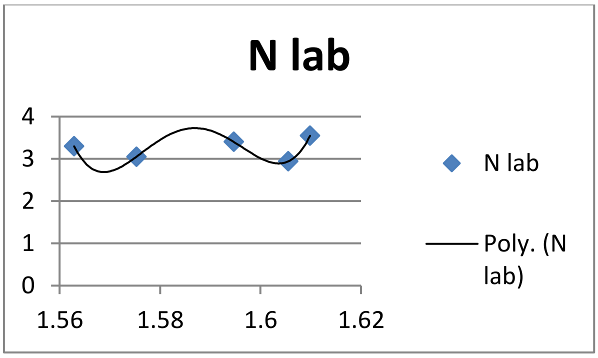


Figure 3: Scattered Plot of Nitrogen (Lab) and (R-B)/G

Figure 4: Fitted Curve for the Data

IV. RESULT AND CONCLUSION

Non linear regression was applied for estimation and observed that (R+B)/G shows good results. The regression analysis equation obtained for (R+B)/G using smoothing with moving average at the span of 4. The regression of y on x is as shown in following equation.

$P1*X^4 + P1*X^{3+} P1*X^{2+} P1*X^{+} P1$ (1)

This regression gives the best fitted curve of 0.98. So we can conclude that images taken in natural light and conditions shows good correlation with the nitrogen and can be used to calculate nitrogen in less cost and time.

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