e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:03/Issue:06/June-2021 Impact Factor- 5.354 www.irjmets.com

BACK PROPAGATION NEURAL NETWORK FOR ESTIMATING OF NITROGEN IN PLANTS

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ABSTRACT

The excessive use of fertilizers is a serious threat for environment, at the same time estimated use of fertilizer increases the crop productivity. Nitrogen (N) in plants is a component of chlorophyll, which is required for photosynthesis, has a significant role in ensuring grow and development of plants. As per the study nitrogen (N) emissions contributes and considered the one of the main element of environment imbalance. For the precision farming and prediction of crop and productivity the assessment of nitrogen content in plants is an important aspect. The estimation of nitrogen content supports decisions making towards the smart farming. In this study, using back propagation neural networks with image analysis the content of nitrogen in plants' has been proposed. The prime objective is to taking the different images of leaves and analysis of its Read Green Blue (RGB), or HIS values with the help of neural network. Back Propagation neural network based system suggests the required nitrogen for better crop and minimum pollution. Another objective of this proposed research is to develop a low-cost, image-based nitrogen content prediction in the leaves by using a conventional digital camera.

Keywords: Neural Network, Back Propagation, Nitrogen, Crops, Soil.

I. INTRODUCTION

Precision farming means specific crop management where water, fertilizer and chemical are used in balanced quantity in soil to boost the productivity. Less production cost and less environment pollution are also being considered [1]. The use of estimated controlled fertilizers to enhance the efficiency is preferred [2]. The study and analysis of nitrogen status in plant, leaves support the precision farming. There are many applications and way to find the nitrogen content in plants, image processing using artificial neural network one of the efficient way. Nitrogen is a macronutrient and component of chlorophyll. This component ensures the growth of plant so it's an essential component. The old conventional method to identify the nitrogen content is a chemical or combustion test.

In conventional agricultural farming where resources such as fertilizer, insect killer and water are functional uniformly without on specified purpose and randomly. Such type of practices will cause the increased soil treatment [3]. For smart farming and precision decision soil and crop properties are need to be analyzed and that depend on:

a) Soil composition such as sand, silt, loam or clay

b) pH value -acidity

c) Soil content -organic matter, water and minerals

d) Density of crops

e) Water and minerals content of crops

Precision farming or precision agriculture is an information technology based advanced technique that optimized the negative impact of environment and increased crop productivity [4].

II. LITERATURE REVIEW

A leaf color chart, as seen in Figure 1, is developed to calculate the green color intensity of crop leaves [5]. Initially it is developed for rice crops but can be applied for wheat, sugarcane onion and similar narrow ling leaves [6]. The leaf's standard color chart and comparison is shown in figure 2 [7].

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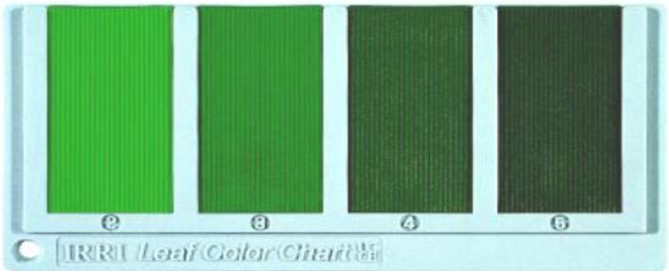

Figure 1: Leaf color chart

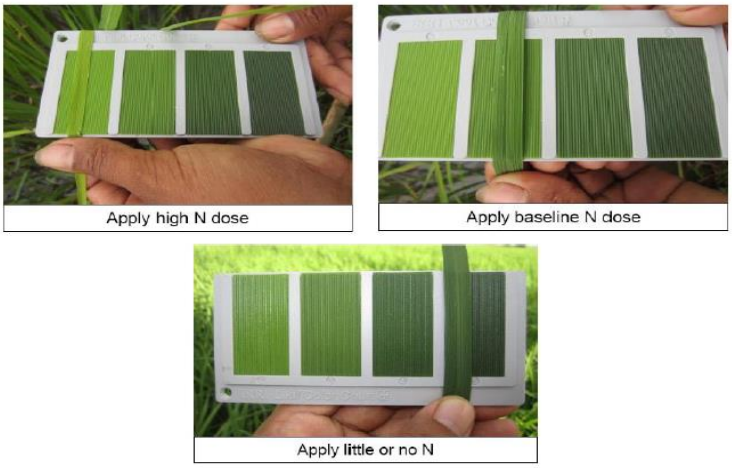

Figure 2: Leaf color comparison with standard chart for nitrogen evaluation

Literature review summarizes the following different processes and techniques concerning the detection of plant grow and analysis:

1) Artificial Neural Network with back Propagation for real time condition [8]
2) Expert system after rain crop study [9]
3) Digital camera based image processing and prediction [10]
4) Image processing for plant disease detection [11]
5) Application of neural network for disease identification [12]

III. PROPOSED METHOD

A. Data Sampling

Data Collection process steps:

(a) Start with taking the image of leaves
(b) Neural Network beaded segmentation
(c) Binary conversion of information
(d) Labeling the information
(e) Remove the noisy data
(f) Display the final color segmented image
(g) Feature extraction.

B. Process flow

a) Image acquisition
b) Color identification training
c) Application of random samples
d) Classification
e) Estimation of nitrogen
f) Error calculation

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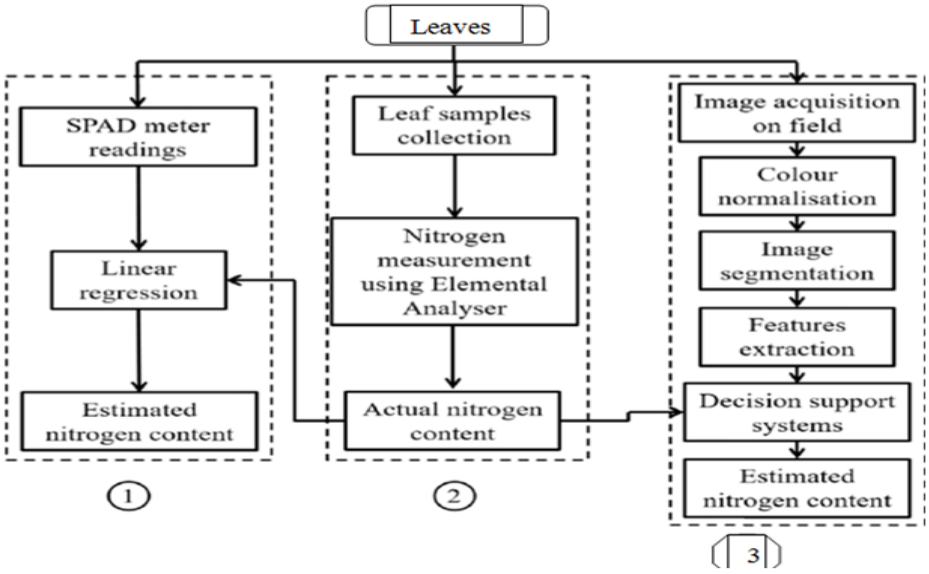
g) Weight adjustment (feedback)

C. Experimental setup and process flow diagram



D. Features Extraction -Nitrogen

Back propagation neural network (BPN) architecture figure 3 training algorithm is being used for image segmentation to distinguish the leaves, based on image processing. The neural network with Multilayer perception (MLP) have input layer, which indentify red, green and blue color values (RGB) for each pixel of the plant images. After that in the next layer of the architecture calculates the nitrogen content. Till then it is feed forward neural network that is the first phase of BPN. In the next attempt of NN is to calculate mean absolute percentage error (MAPE) and finally weight is updated.

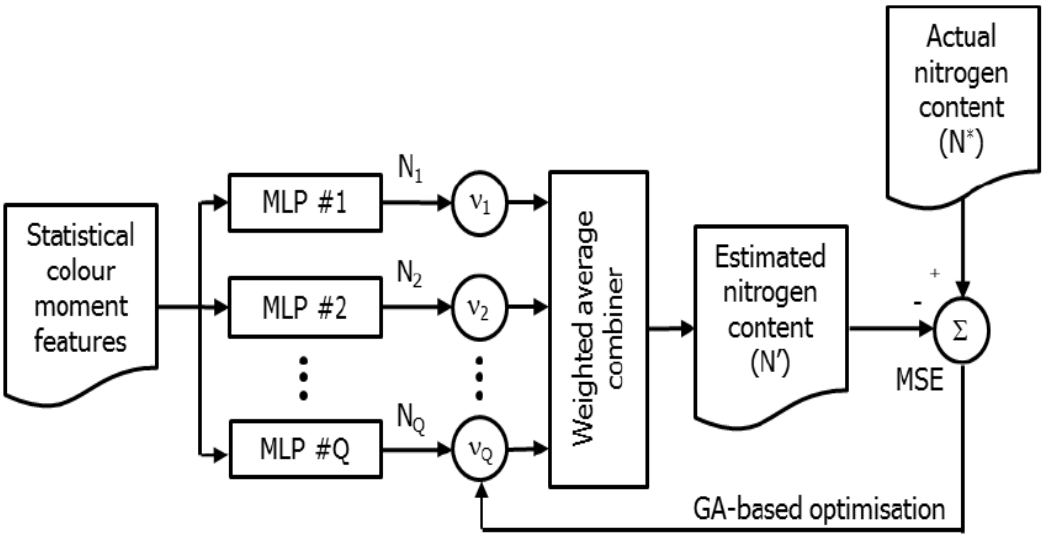


Figure 3: BPN for Color segment and Nitrogen content

E. Evaluation formula error finding:

The level of the prediction accuracy was measured by calculating the mean absolute percentage error (MAPE) for the observed/actual and predicted nitrogen percentage. This error describes how far, in percent, the deviation of the predicted value is from the actual value. The less the error is the superior the prediction. MAPE can be expressed as follows:

Mean Absolute Percentage Error =

$$MAPE = \frac{100\%}{n}\sum_{t=1}^{n}\left|\frac{Na_t - Np_t}{Na_t}\right|$$

Where n = number of samples

Na = actual nitrogen amount

Np = predicted nitrogen amount

IV. DISCUSSION

Other methods for nitrogen estimation are as follows:

(a) Soil Plant Analysis Development (SPAD) meter is commonly used to decide chlorophyll content in leaves by measuring the absorbance of red and infrared lights.
(b) Neural network and committee machines based analysis is a neural network based prediction, the three variables red green blue (RGB) that are used for nitrogen content.
(c) Combustion technique uses the chemical substances for identifying the different properties of leaf.
(d) Kjeldahl method is similar to Combustion technique
(e) Dumas method uses gases, for estimation of different parameters of leaf content.
(f) Vegetation index method is a satellite remote sensing

V. CONCLUSIONS

In a control room and at the presence of artificial lighting system, nitrogen estimation in plants leaves content of plants experiment is commonly conducted. In the proposed method A low cost, nitrogen estimation of leaves is conducted using Back Propagation Neural Network. The proposed method focused on color combination RGB and nitrogen content. Back-propagation neural network has been used for image segmentation and nitrogen content estimation. The variation of sunlight intensities sometimes it is challenging task to accurate estimation of nitrogen content, because the sunlight may considerably change the color of leaf this can be consider as a future work.

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