

FOOT ROT DISEASE IDENTIFICATION FOR VELLAIKODI VARIETY OF BETELVINE PLANTS USING DIGITAL IMAGE PROCESSING

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Abstract

Betelvine plants are infected variety of diseases in the complete plantation without any premature warning of the diseases. The aim of this paper is to detection of foot rot disease in the vellaikodi variety of betelvine plants using digital image processing techniques. The digital images of the uninfected or normal betelvine leaves and the digital images of the infected in foot rot diseased betelvine leaves at different stages are collected from different Betelvine plants using a high resolution digital camera and collected betelvine images are stored with JPEG format. The digital images of the betelvine leaves analyses are done using the image processing toolbox in MATLAB which gives the normal patterns of the digital images. Using RGB encoding process, the RGB components of the betelvine leaves are separated. The mean and median values for all sample leaves are computed and calculated values are stored in the system. The mean and median values of test leaves are computed and compared with the stored values. As the result of this comparison, it is identified whether test leaves are affected by foot rot disease or not. Finally this analysis helps to recognize the foot rot disease can be identified before it spreads to entire crop.

Keywords:

Betelvine, Foot Rot Disease and Phytophthora Parasitica

1. INTRODUCTION

The betelvine is popularly known as pan in Hindi, vettilai in Tamil, vilaadele in Kannada, vettila in Malayalam, pan or videchapana in Marathi and betelvine leaf in English. The betelvine is a glabrous climbing vine belonging to the family Piperaceae. The betelvine leaf is used in a number of traditional medicines for the treatment of stomach complaints, infections and as a general refresher. Some evidence suggests that betelvine leaves have immune boosting properties as well as anti-cancer properties. Fresh juice of betelvine leaves is also used in many ayurvedic preparations [1]. Betelvine is widely cultivated in the states of Tamil Nadu, Uttar Pradesh, Bihar, Madhya Pradesh, Northeastern India, Maharashtra, Karnataka, West Bengal, Orissa, Andhra Pradesh, Kerala and Andamans [6]. In Tamilnadu, based on the color, size and taste there are many varieties of betelvine leaf and some of the most popular varieties are vellaikodi, Karpoori, pachaikodi and Sirugamani are mostly available. In this paper only consider vellaikodi variety of betelvine leaves. The group of research is going on in the field of betelvine diseases analysis for various centers within the country under the name "ALL INDIA NETWORKING PROJECT IN BETELVINE". During cultivation betelvine is very much affected by diseases and outcome of the farmer is big loss for betelvine cultivation. The most important diseases of betelvine leaf are Foot Rot, Powdery mildew, Leaf Rot and Leaf Spot. It occurs in a very powerful form and if not controlled,

causes unlimited damage and even total demolition of the entire of betelvine plantations. The farmer is not able to identify the disease at an early stage to initiate preventive action due to the non-availability of modern technology. So for each farmer, to have access to the modern technology there is a need to construct modern commercial farm. This has been the base to develop a new tool to identify the disease well in advance to enhance the cultivation. Digital Image processing is used as a tool for early identification of the Foot Rot disease.

2. NEW METHOD FOR FOOT ROT DISEASE IDENTIFICATION

Mostly when a farmer visualizes the Foot Rot disease, seen as a change in the form of color or appearance the disease is in the matured stage after which diagnosis cannot save the plant. The disease increases to the complete crop and the total plantation gets destructed within few days [4]. Foot Rot disease appears on the disease starts from the roots or rootlets. Human eye cannot predict the disease at an early stage. So we are using computerized image analyzing system in which minute change in the form of color in leaves can be detected at an early stage.

3. BETELVINE PLANT FOOT ROT DISEASE

Foot Rot is caused by the fungus *Phytophthora parasitica* that lives in the soil and attacks roots, stem and leaves. The photograph is shown in Fig.1. The diseased plant at this stage exhibits a general pallor and drooping of the tender shoots. The aerial parts, leaves or stem do not show any other sign of infection such as lesions or rotting. Such plants when pulled out easily break at the collar region and underground parts are found to be in the state of decay.



Fig.1. Foot Rot Disease Affected Betelvine Plants

The roots and rootlets are found to be black or brown, and in decaying condition. Wilting is dependent on the extent of infection, rapidity of infection in the internodes and the position of the internodes. If the internodes just below the ground surface are infected, the plants wilt very suddenly as if they are cut off from all possible sources of water and food. When the infection is first evident in internodes away from the soil surface, the aerial parts of the plants appear to remain normal and healthy for a long time as the internodes above the diseased portion still continue to function.

The disease in internodes can be easily detected by the blackening of the tissues inside. The infection to aerial parts does not usually extend beyond one or two internodes because the plant is killed before the disease progresses further. The appearance and spread of the disease is dependent on external factors. When the atmospheric humidity is high and the temperature is low, the disease develops rapidly, whereas under dry conditions the progress of the disease is slow.

4. METHODOLOGY FOR FOOT ROT DISEASE IDENTIFICATION

The betelvine leaves are correctly washed to eliminate the dust components. Digital imaging technique is divided in three phases respectively as,

- 1) Normal or uninfected betelvine leaves phase
- 2) Foot rot disease infected betelvine leaves phase
- 3) Test betelvine leaves phase

Normal or uninfected betelvine leaves phase consists of without any disease infected in the betelvine leaves. The normal or uninfected betelvine Plant and the front and back view of normal or uninfected betelvine plants are shown in Fig.2 and infected betelvine leaves are shown in Fig.3. Infected betelvine leaves phase consisted of visually unidentifiable infected betelvine leaves to visually identifiable infected betelvine leaves. The samples are collected various stages of foot rot disease and the front and back view of foot rot disease infected betelvine leaves are shown in Fig.4. Test leaves phase consists of visually unidentifiable infected betelvine leaf, samples are collected at various stages of the foot rot disease.



Fig.2. Normal or uninfected betelvine Plant

The front and back view of foot rot disease infected betelvine leaves are shown in Fig.5. Ten samples from each phase were taken for this paper. The size of all the digital images is 256×256 . To eliminate the background using Photoshop 7.0 and background was chosen to be white color and these digital images are stored in the system. These stored digital images are given as input to the MATLAB file and the RGB color components are separated and find the mean and median values for all healthy and foot rot disease infected leaves and calculated values are stored in the system. For the test leaf, compute mean and median values and compare all the stored values, to recognize the diseased betelvine leaf affected by foot rot disease.

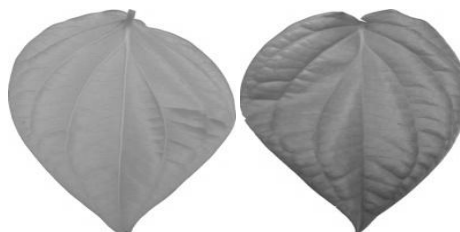


Fig.3. The front and back view of normal leaf

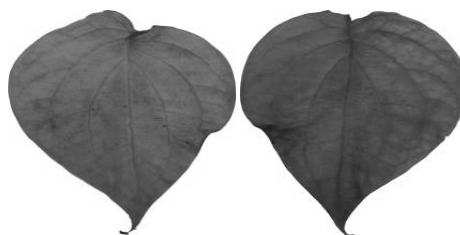


Fig.4. The front and back view of infected leaf

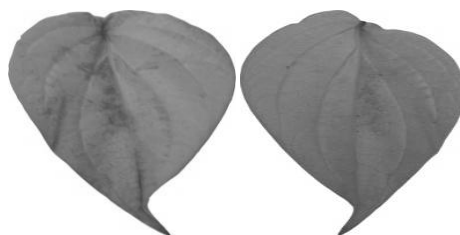


Fig.5. The front and back view of Test leaf

5. RESULT

5.1 EXPERIMENT 1

The first experiment result of the paper is all the normal and infected leaves are given as input to the MATLAB and RGB color components are separated. The mean value are calculated for front and back view of each component and calculated mean value are stored in the system and test leaves are given as input to the MATLAB. The RGB color components are separated and the mean value are calculated for front and back view of each component and calculated mean value are stored in the system. To compare all the stored results and identify either disease infected or not in the test betelvine leaf, the mean value of Red component for normal leaves and infected leaves front and back views are shown in Fig.6 and Fig.7. The mean value of green component for normal leaves and infected leaves front and back

views are shown in Fig.8 and Fig.9. The mean value of Blue component for normal leaves and infected leaves front and back views are shown in Fig.10 and Fig.11. In normal leaves, mean value for front view of Red component value ranges from 33.01 to 36.90 and mean value for back view of Red component value ranges from 34.07 to 41.89. In infected in Foot rot disease at first day leaves, mean value for front view of Red component value ranges from 42.01 to 49.92 and mean value for back view of Red component value ranges from 42.17 to 49.99.

mean value for back view of Red component value ranges from 62.55 to 68.76. In infected in Foot rot disease at fifth day leaves, mean value for front view of Red component value ranges from 26.51 to 32.81 and mean value for back view of Red component value ranges from 26.61 to 39.42. In first three samples of test leaves, mean value for front view Red component value ranges from 33.01 to 36.90 and mean value for back view of Red component value ranges from 34.07 to 41.89. In fourth, fifth and sixth samples of test leaves, mean value for front view Red component value ranges from 42.01 to 49.92 and mean value for back view of Red component value ranges from 42.17 to 49.99. In seventh and eighth samples of test leaves, mean value for front view Red component value ranges from 37.36 to 41.61 and mean value for back view of Red component value ranges from 54.02 to 59.99.

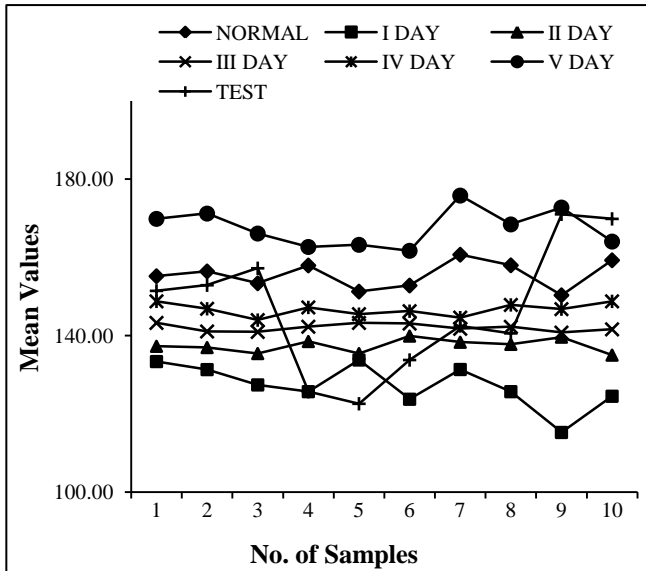


Fig.6. Front View for Red Component

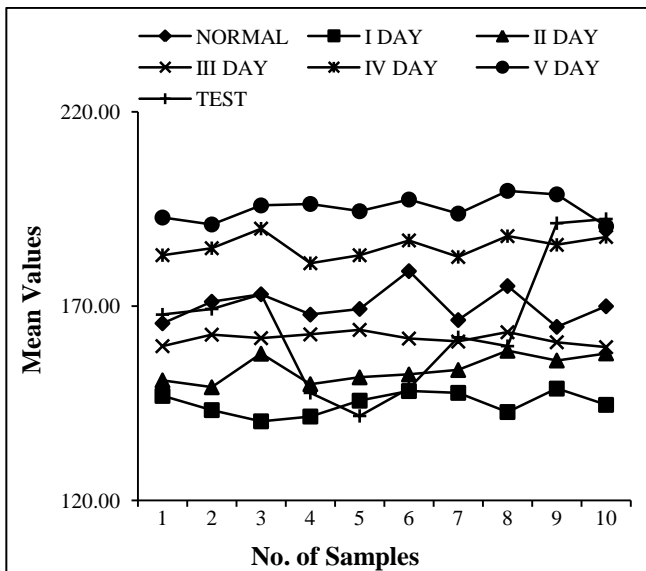


Fig.7. Back View for Red Component

In infected in Foot rot disease at second day leaves, mean value for front view of Red component value ranges from 42.01 to 49.92 and mean value for back view of Red component value ranges from 42.17 to 49.99. In infected in Foot rot disease at third day leaves, mean value for front view of Red component value ranges from 37.36 to 41.61 and mean value for back view of Red component value ranges from 54.02 to 59.99. In infected in Foot rot disease at fourth day leaves, mean value for front view of Red component value ranges from 52.83 to 63.33 and

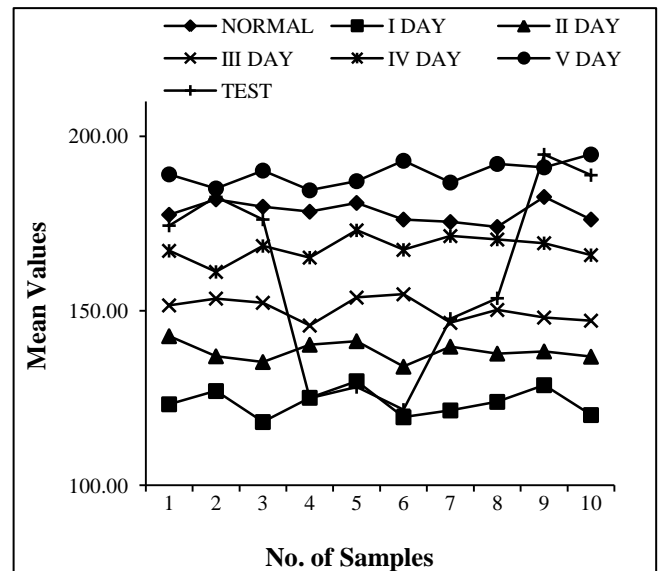


Fig.8. Front View for Green Component

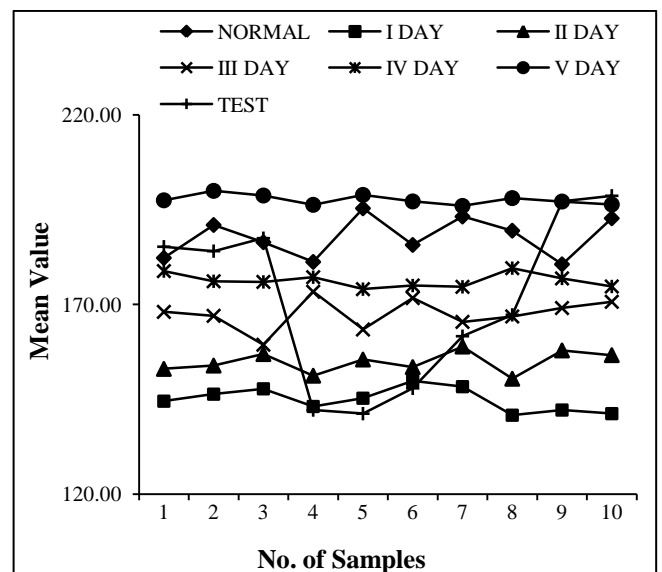


Fig.9. Back View for Green Component

In last two samples of test leaves, mean value for front view Red component value ranges from 26.51 to 32.81 and mean value for back view of Red component value ranges from 26.61

to 39.42. In normal leaves, mean value for front view of Green component value ranges from 24.83 to 30.65 and mean value for back view of Green component value ranges from 30.23 to 39.79. In infected in Foot rot disease at first day leaves, mean value for front view of Green component value ranges from 41.14 to 51.39 and mean value for back view of Green component value ranges from 43.35 to 54.98.

In infected in Foot rot disease at second day leaves, mean value for front view of Green component value ranges from 41.14 to 51.39 and mean value for back view of Green component value ranges from 43.35 to 54.98. In infected in Foot rot disease at third day leaves, mean value for front view of Green component value ranges from 54.28 to 64.66 and mean value for back view of Green component value ranges from 57.14 to 64.93. In infected in Foot rot disease at fourth day leaves, mean value for front view of Green component value ranges from 66.16 to 69.66 and mean value for back view of Green component value ranges from 72.28 to 78.84. In infected in Foot rot disease at fifth day leaves, mean value for front view of Green component value ranges from 31.05 to 46.32 and mean value for back view of Green component value ranges from 23.45 to 29.76. In first three samples of test leaves, mean value for front view Green component value ranges from 26.51 to 32.81 and mean value for back view of Green component value ranges from 26.61 to 39.42. In fourth, fifth and sixth samples of test leaves, mean value for front view Green component value ranges from 41.14 to 51.39 and mean value for back view of Green component value ranges from 43.35 to 54.98. In seventh and eighth samples of test leaves, mean value for front view Green component value ranges from 54.28 to 64.66 and mean value for back view of Green component value ranges from 57.14 to 64.93. In last two samples of test leaves, mean value for front view Green component value ranges from 31.05 to 46.32 and mean value for back view of Green component value ranges from 23.45 to 29.76.

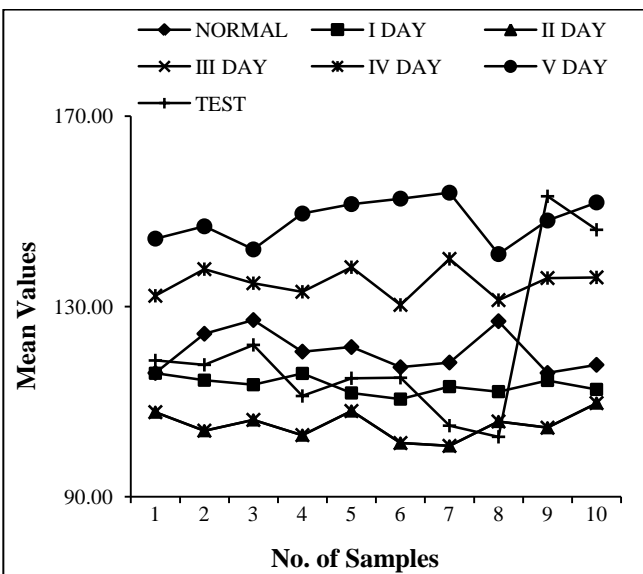


Fig.10. Front View for Blue Component

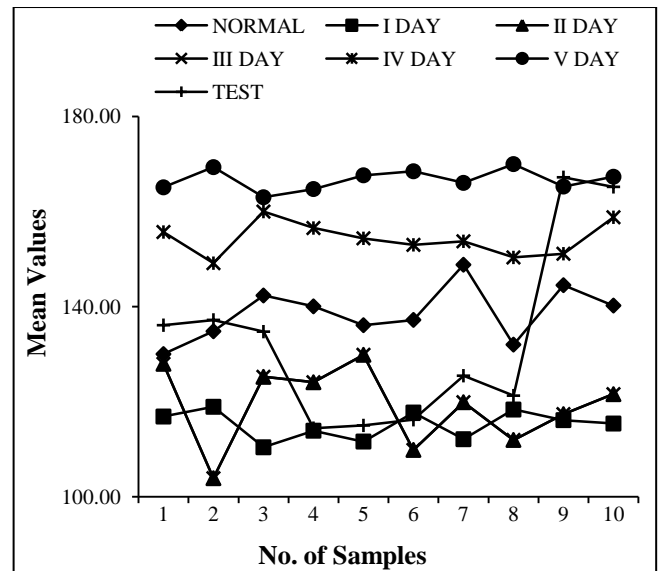


Fig.11. Back View for Blue Component

In normal leaves, mean value for front view of Blue component value ranges from 46.02 to 52.31 and mean value for back view of Blue component value ranges from 46.11 to 59.94. In infected in Foot rot disease at first day leaves, mean value for front view of Blue component value ranges from 32.69 to 39.91 and mean value for back view of Blue component value ranges from 30.21 to 39.72. In infected in Foot rot disease at second day leaves, mean value for front view of Blue component value ranges from 40.08 to 44.76 and mean value for back view of Blue component value ranges from 62.10 to 69.80. In infected in Foot rot disease at third day leaves, mean value for front view of Blue component value ranges from 55.23 to 59.83 and mean value for back view of Blue component value ranges from 79.23 to 85.56. In infected in Foot rot disease at fourth day leaves, mean value for front view of Blue component value ranges from 61.00 to 69.95 and mean value for back view of Blue component value ranges from 87.35 to 94.66. In infected in Foot rot disease at fifth day leaves, mean value for front view of Blue component value ranges from 71.65 to 78.98 and mean value for back view of Blue component value ranges from 95.22 to 103.96. In first three samples of test leaves, mean value for front view Blue component value ranges from 46.02 to 52.31 and mean value for back view of Blue component value ranges from 46.11 to 59.94. In fourth, fifth and sixth samples of test leaves, mean value for front view Blue component value ranges from 32.69 to 39.91 and mean value for back view of Blue component value ranges from 30.21 to 39.72. In seventh and eighth samples of test leaves, mean value for front view Blue component value ranges from 55.23 to 59.83 and mean value for back view of Blue component value ranges from 79.23 to 85.56. In last two samples of test leaves, mean value for front view Blue component value ranges from 71.65 to 78.98 and mean value for back view of Blue component value ranges from 95.22 to 103.96.

To compare all the ten test sample leaves of mean values from stored mean values of normal and infected leaves. The result is first three test sample leaves are uninfected or normal leaves. In fourth, fifth and sixth test sample leaves are infected in first day for Foot rot disease. In seventh and eighth test sample

leaves are infected in third day for Foot rot disease. In last two tests sample leaves are infected in fifth day for Foot rot disease.

5.2 EXPERIMENT 2

The second experiment result of the paper is all the normal and infected leaves are given as input to the MATLAB and RGB color components are separated. The median value are calculated for front and back view of each component and calculated median value are stored in the system and test leaves are given as input to the MATLAB and RGB color components are separated and the median value are calculated for front and back view of each component and calculated median value are stored in the system. To compare all the stored results and identify either disease infected or not in the test betelvine leaf, the median value of Red component for normal leaves and infected leaves front and back views are shown in Fig.12 and Fig.13. The median value of green component for normal leaves and infected leaves front and back views are shown in Fig.14 and Fig.15. The median value of Blue component for normal leaves and infected leaves front and back views are shown in Fig.16 and Fig.17.

In normal leaves, median value for front view of Red component value ranges from 104 to 120 and median value for back view of Red component value ranges from 130 to 152. In infected in Foot rot disease at first day leaves, median value for front view of Red component value ranges from 61 to 67 and median value for back view of Red component value ranges from 74 to 89. In infected in Foot rot disease at second day leaves, median value for front view of Red component value ranges from 71 to 82 and median value for back view of Red component value ranges from 94 to 98. In infected in Foot rot disease at third day leaves, median value for front view of Red component value ranges from 88 to 94 and median value for back view of Red component value ranges from 103 to 112. In infected in Foot rot disease at fourth day leaves, median value for front view of Red component value ranges from 97 to 103 and median value for back view of Red component value ranges from 116 to 124.

In infected in Foot rot disease at fifth day leaves, median value for front view of Red component value ranges from 134 to 143 and median value for back view of Red component value ranges from 125 to 129. In first three samples of test leaves, median value for front view Red component value ranges from 104 to 120 and median value for back view of Red component value ranges from 130 to 152. In fourth, fifth and sixth samples of test leaves, median value for front view Red component value ranges from 61 to 67 and median value for back view of Red component value ranges from 74 to 89.

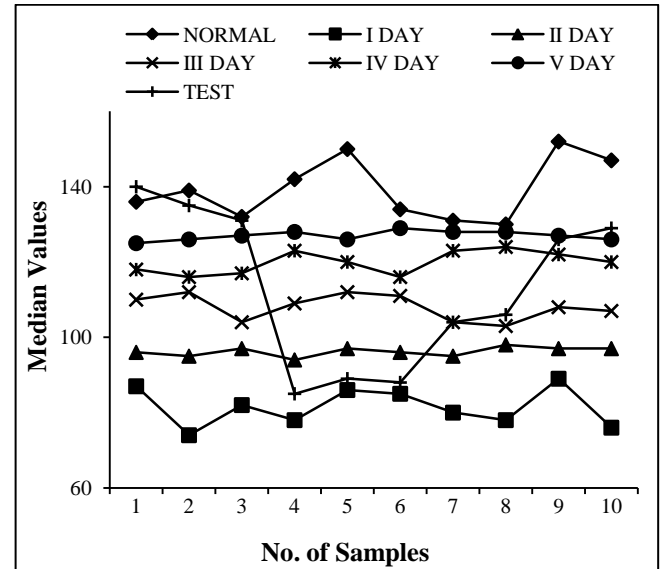


Fig.13. Back View for Red Component

In seventh and eighth samples of test leaves, median value for front view Red component value ranges from 88 to 94 and median value for back view of Red component value ranges from 103 to 112. In last two samples of test leaves, median value for front view Red component value ranges from 134 to 143 and median value for back view of Red component value ranges from 125 to 129. In normal leaves, median value for front view of Green component value ranges from 127 to 149 and median value for back view of Green component value ranges from 150 to 175. In infected in Foot rot disease at first day leaves, median value for front view of Green component value ranges from 39 to 69 and median value for back view of Green component value ranges from 85 to 97. In infected in Foot rot disease at second day leaves, median value for front view of Green component value ranges from 76 to 83 and median value for back view of Green component value ranges from 102 to 107. In infected in Foot rot disease at third day leaves, median value for front view of Green component value ranges from 86 to 99 and median value for back view of Green component value ranges from 110 to 121. In infected in Foot rot disease at fourth day leaves, median value for front view of Green component value ranges from 100 to 112 and median value for back view of Green component value ranges from 124 to 135. In infected in Foot rot disease at fifth day leaves, median value for front view of Green component value ranges from 115 to 124 and median value for back view of Green component value ranges from 139 to 148. In first three samples of test leaves, median value for front view Green component value ranges from 127 to 149 and median value for back view of Green component value ranges from 150

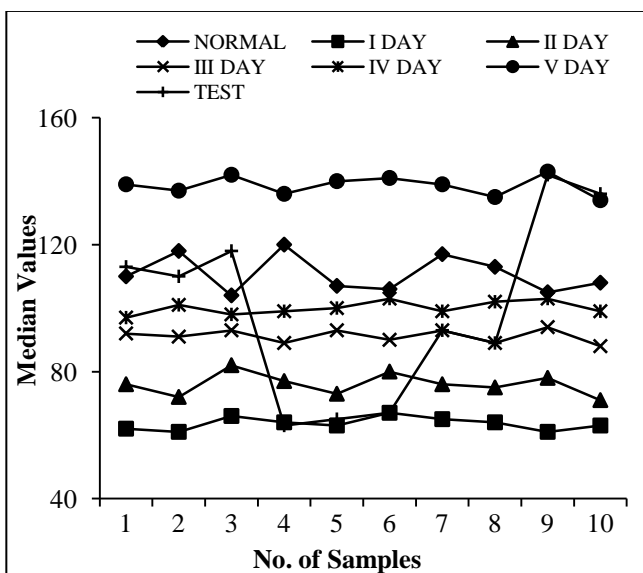


Fig.12. Front View for Red Component

to 175. In fourth, fifth and sixth samples of test leaves, median value for front view Green component value ranges from 39 to 69 and median value for back view of Green component value ranges from 85 to 97.

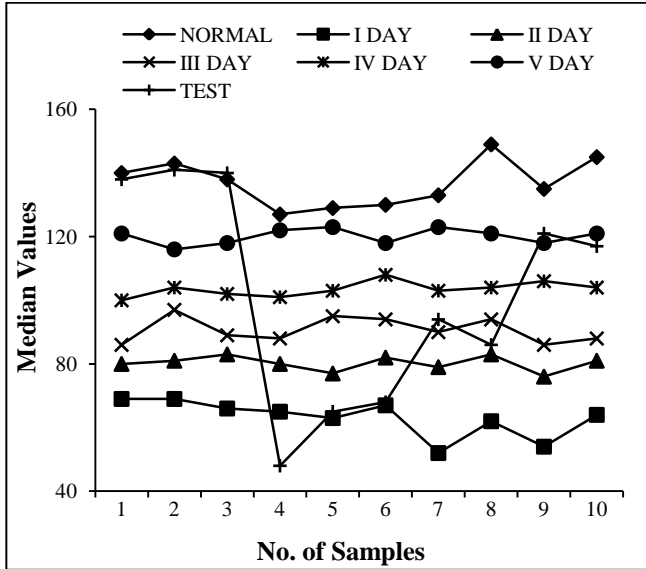


Fig.14. Front View for Green Component

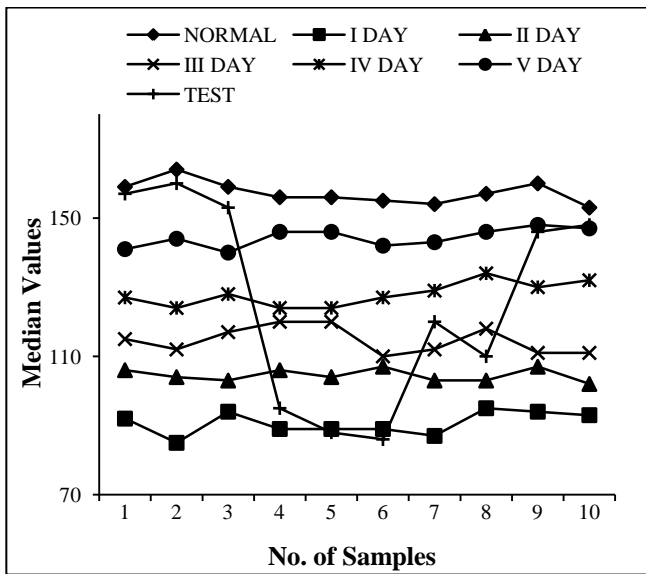


Fig.15. Back View for Green Component

In seventh and eighth samples of test leaves, median value for front view Green component value ranges from 86 to 99 and median value for back view of Green component value ranges from 110 to 121. In last two samples of test leaves, median value for front view Green component value ranges from 115 to 124 and median value for back view of Green component value ranges from 139 to 148. In normal leaves, median value for front view of Blue component value ranges from 48 to 58 and median value for back view of Blue component value ranges from 76 to 91. In infected in Foot rot disease at first day leaves, median value for front view of Blue component value ranges from 23 to 29 and median value for back view of Blue component value ranges from 43 to 49. In infected in Foot rot disease at second day leaves, median value for front view of Blue component

value ranges from 33 to 38 and median value for back view of Blue component value ranges from 31 to 38. In infected in Foot rot disease at third day leaves, median value for front view of Blue component value ranges from 40 to 47 and median value for back view of Blue component value ranges from 52 to 63. In infected in Foot rot disease at fourth day leaves, median value for front view of Blue component value ranges from 64 to 76 and median value for back view of Blue component value ranges from 66 to 74.

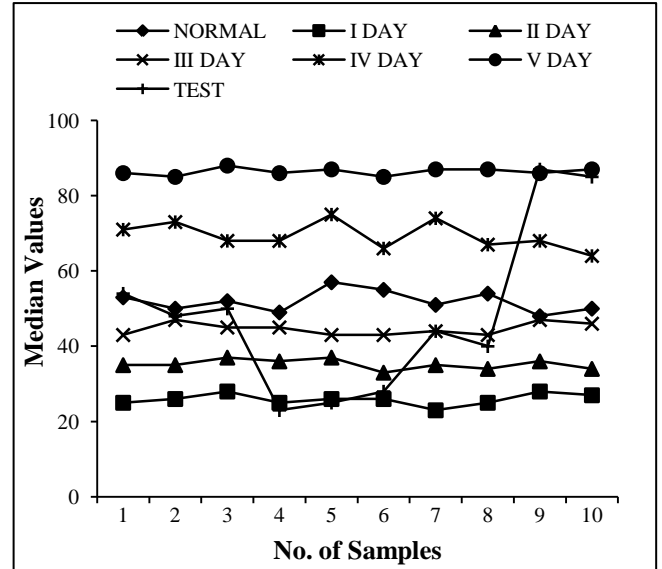


Fig.16. Front View for Blue Component

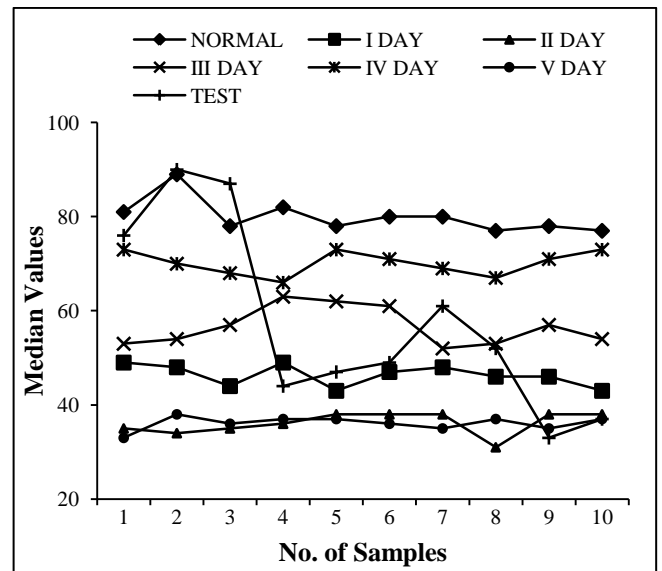


Fig.17. Back View for Blue Component

In infected in Foot rot disease at fifth day leaves, median value for front view of Blue component value ranges from 82 to 88 and median value for back view of Blue component value ranges from 32 to 38. In first three samples of test leaves, median value for front view Blue component value ranges from 48 to 58 and median value for back view of Blue component value ranges from 76 to 91. In fourth, fifth and sixth samples of test leaves, median value for front view Blue component value ranges from 23 to 29 and median value for back view of Blue

component value ranges from 43 to 49. In seventh and eighth samples of test leaves, median value for front view Blue component value ranges from 40 to 47 and median value for back view of Blue component value ranges from 52 to 63. In last two samples of test leaves, median value for front view Blue component value ranges from 82 to 88 and median value for back view of Blue component value ranges from 32 to 38. To compare all the ten test sample leaves of median value from stored median value of normal and infected leaves. The result is first three test sample leaves are uninfected or normal leaves. In fourth, fifth and sixth test sample leaves are infected in first day for Foot rot disease. In seventh and eighth test sample leaves are infected in third day for Foot rot disease. In last two tests sample leaves are infected in fifth day for Foot rot disease.

6. CONCLUSION

The above proposed methods convey that the betelvine plants disease can be identified disease infected or not in the betelvine leaf and thus preventive action can be taken well in advance such that the entire plantation can be saved before the disease starts to spread. The method of detecting the disease is cost effective. The efficiency of the system can be increased by taking the camera parameters, as the camera parameters are considered constant in this project. Periodic inspection of the farm is required to prevent the disease. This method can also be extended to detect diseases of all kind to initiate early preventive action.

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