METHODS OF DETECTION PLANT DISEASE

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ABSTRACT

Disease in plant cause major production and economic losses as well as reduction in both quality & quantity of agricultural products. In this paper we studied and evaluate existing techniques for detection of plant diseases by this method we monitoring plant health and detecting pathogens to reduce disease spread and facilitate effective management practices.

In order to minimize the disease include damage in crop during growth harvest and post-harvest processing as well as to maximize productivity and ensure agricultural sustainability some advanced disease detection and prevention in crops are imperative. This paper reviews the direct and indirect disease identification methods currently used in agriculture laboratory based technique such as polymerase chain reaction (PCR) immune fluorescence enzyme linked immunosorbent assay (ELISA) gas chromatography mass spectrometry are some direct method and indirect method includes hyper spectral technique thermography etc.

Keywords: *Pathogens, immunofluorescence, Chromatography hyper spectral technique.*

INTRODUCTION

In India most of the people depend on agriculture research in agriculture is aimed towards increase of productivity and food quality at reduced expenditure with increased profit. Many big and small scale industries are depending on agriculture sector for their raw material.

Plant disease is responsible for major economic losses in the agricultural industry worldwide detection and classification of plant diseases are important task to increase plant productivity and economic growth about 42% of the worlds agriculture harvest is destroyed yearly by disease and pest looses of harvest can be minimized and specific treatment can be applied if plant disease are correctly identified early.

Plant disease is most important cause that reduces quality of agricultural products the abnormal functioning of plant is due to disease and this diseases are cured due to pathogens like bacteria, viruses, fungi, one another condition of plant disease are change in environrnental condition and this disease found any part of the plant, like fruit, leaf vegetable, root, stem. Monitoring such disease at different part of plant is critical for sustainable agriculture. It is investigated that the losses in crop yield due to pathogen are ranges between 22% to 40% and on average the losses of maize, barley, rice and soybean are 13%, groundnut and potato are ranged 23%, wheat are 51% and cotton upto 82% and the economic losses due to infected plant are 42 billion collars.

There are various techniques are also investigate to determine plant diseases which include directs and indirect method direct method include polymarese chain reaction (PCR), immunofluoresence fluorescence in situ hybridisafion, enzyme-linked immunosorbent assay flow cytometer, gas chromatography mass spectrometry. While indirect method includes thermography, fluorescence imaging and hyper spectral technique. In some techniques only image of plant is required to identify disease that type

methods include remote sensing, image processing method etc.

So this paper is focused on such identification of curing plant diseases to increase productivity & quality of the plant.

METHODOLOGY

Following direct methods are currently used for detection of diseases in plant.

1) Polymerase chain Reaction:

This method is depends on fidelity of DNA hybridization and replication. It is used for detection of disease caused by bacteria and viruses but now it is used for detection of plant pathogens due to high sensitivity of PCR it is also used for identification of plant pathogens.

2) Fluore science in situ Hybridization:

It is the second method for detection of diseases in crop it is applied for Bacterial detection it is the combination of microscopy and hybridization of DNA probes and target gene from plant sample FISH can detect the pathogen infection in plants due to the presence of pathogen specific ribosomal RNA sequence in plants. FISH can also detect the fungi and viruses and other endosymbiotic bacteria but the practical limit of detection lies both in the range of around 10_3 CFU/ML FISH could also use to detect uncultivable organisms in order to investigate complex microbial communities. Accuracy and reliability of FISH is highly dependent on the specificity of nucleotide probes.

3) Enzyme linked Immunosorbent Assay:

It is the another molecular method for identification of diseases based on antibodies and change in assay this method detect the infected crop by visualizing based on color change resulting from the interaction between the substrate and immobilized enzyme. It increase it's performance with the help of specific monoclonal and recombinant antibodies. Which are commercially available for plant disease detection tissue print ELISA and lateral flow devices that enable detection have been fabricated for on situ detection. So it is useful only for confirmation of plant diseases after visual symptoms appear but not for early detection before disease symptom occur.

4) Immunofluorescence:

It is the microscopic – based optical technique which is used for analysis of microbiological samples this method detect the diseases in plant tissue. The detection is done by conjugating a fluorescent dye to the specific antibody to visualize the distribution of plant molecule throughout the sample. It also detect the fungus Botrytis cinerea which infect onion crop. It detects the infection in potatoes with the help of other technique.

5) Flow cytometry:

It is based on laser-optical technique. This is widely used for counting and sorting biomarkers detection and protein engineering. It is also used for rapid identification of cells. The most important used of this technique is that it has capability for simultenues measurement of several parameters. This method used the laser beam to measure the scattering and fluorescence of laser beam reflects from the sample. It is also used to study cell cycle kinetics and antibody susceptibility.

Some indirect methods are also used for detection of plant diseases which include following.

I) Thermography:

In this method the infrared radiation are emitted for detection of plant disease. These infrared radiations which are emitted by thermographic cameras detect the colour difference in the plant and the result can be taken from ther mographic imaging. It is also used to identify hetregenecity in the infection of soil borne pathogens this technique is also limited due to its high sensitivity to the change of environmental conditions during measurements, and con not used for the identification the type of infection.

II) Fluorescence Imaging:

This method detect the inflection by measuring the chlorophyll fluorescence on the leaves and the change in fluorescence can be used to identify pathogenic infection it detect leaf rust and mildew infections in wheat leaves by using temporal and spatial variation of chlorophyll fluorescence. It also detect the abnormalities in the photosynthesis but it is limited in field setting.

III) Hyperspectral techniques:

This technique gives the useful information of plant health between the range of spectruan 350 to 2500 nm. It is widely used for plant phenotyping and crop disease identification in high scales of agriculture. It gives the fast analysis of the imaging data this technique collect the data by hyper spectral imaging cameras in three dimensions'. Which gives the accurate information about plant health. It measures the change in reflectance resulting from the biophysical and biochemical characteristic the infection on rice, tomato and apple plant can be identify by this technique.

IV) Gas Chromatography:

The volatile nature of plants could be analysed by using gas-chromatography technique to analyses the presence of volatile organic compound (VOC) that is indicative of particular plant diseases. The gas chromatography along with mass spectrometry is used to enhance the performance of compound separation and analyses. GC-MS can provide more accurate information about plant disease as compared to other techniques it gives the information of plant diseases at different stage. Which is based on information collected from VOC sample.

RESULT

The present paper focused be detection of plant diseases all methods gives various techniques detection and curing of plant diseases by different method. The comparison of all method for detecting plant diseases with their advantages and limitations are given in following table. Table shows methods used in direct technique some indirect methods are applicable for detection of plant diseases like thermography, fluorescence imaging hyper spectral technique and gas chromatography. All these methods are detect plant disease by their own processes like taking image by camera or by analyzing volatile compounds.

Thus all these methods gives the way that how to decrease the plant diseases of increase productivity of quality & that infected crop.

Technique	Limit of detection (CFU/ML)	Advantages	Limitations
PCR	$10^2 – 10^4$	Mature and common technology easy to operate.	Effectiveness is subjected to DNA extraction, inhibitors, polymerase activity, conc of PCR buffer and deongnucleoside triphosphate
FISH	10^3	High Sensitivity	Autoflurescence, Photobleaching
ELISA	$10^4 – 10^6$	Low, cost, visual colour change can be used for detection	Low sensitivity for Bacteria
IF	10^3	High sensitivity, target distribution can be visualized	Photobleaching
FCM	10^4	Simultaneous measurement of several parameters, rapid detection	High cost, over whelming unnecessary information

PCR - Polymarase chain reaction
FISH -Fluorescence in situ hybridization
ELISA -Enzyme- linked immunosor bent assay
IF -Immunofluorescence
FLM -Flow cytometry
CFU -Colons Forming Unit

CONCLUSION

The current paper review the new advanced techniques used for detection of plant diseases. Which is caused by pathogen live Viruses, Bacteria, Fungus the methods such as PCR, FISH, ELISA. IF, FCM and GC are widely used for plant diseases detection but it seen that during determination these methods are difficult to operate & time consuming and also have other limitations. While the techniques like thermography, fluorescence imaging are also used on field for detection of disease on infected plant. There methods does not have such drawbacks like direct method.

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