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Advanced Detection Technologies in Plant Pathogen

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The field of plant pathology has recently seen the development of several new techniques aimed at improving disease detection, diagnosis and management. These techniques are rooted in Advanced technologies, including nanotechnology, biosensors and IOT integration, volatile organic compound, RGB imaging, next generation sequencing, Nucleic acid a visual detection systems, robots and satellites etc.

Nanotechnology in Disease Detection

Nanotechnology has been applied to detect plant pathogen at vey low concentration by using of tiny nanoparticles are used to detect and create portable diagnostic devices that can identify the plant pathogen from field level. Mainly used in Wheat, Corn, Tomato detecting or showing signs of disease. Eg: the solution might turn from clear to a bright red color like red or green. Displays with Graph as data form updates on the plant health.

Volatile Organic Compounds

VOC sensors detect the specific volatile compounds which is emitted by plants when they are infected by pathogens. Advanced diagnose of detect the early symptoms in plants and also maintain the plant defence mechanisms – create signals to the neighbouring plants, warning them of potential danger. Due to this the neighbouring plants produce defence mechanisms against the particular pathogen. Mainly used for Early and Late Blight of Tomato produced 95% accurancy senors.

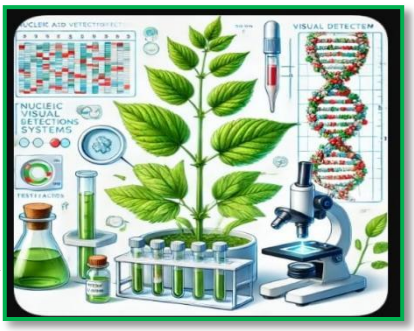
Next Generation Sequencing Sensors

The scene captures a modern laboratory , fast and cost effective method .The focus is on a sequencing machine processing specific DNA used to identify plant causing pathogen, with a compute used to displaying specific genetic sequences and complex

data visualizations. Analyze large numbers of DNA sequences to understand how diseases affect different plant hosts.

Nucleic Acid Visual Detection Systems

These systems use isothermal application to identify pathogens and include like [LAMP],Cas,[RPA],[RCA] etc… Mainly used to quick detect of plant pathogen and also detecting specific .nucleic acid [dna/rna] sequence in plant pathogen. Low cost and easy accessible technology because it used to detect the disease on-site without need for complex laboratory.



RESULT: LOOP MEDIATED ISOTHERMAL APPLICATION – used to produce colorimetric read out, amplify the genetic material at constant temperature in a solution. Mainly used in BBTV – Banana bunchy top virus.

RGB IMAGING: [RED, GREEN, BLUE] imaging is a valuable tool in plant pathology, used to assess plant health, detect diseases and monitor crop conditions. By capturing images of plants in the visible spectrum, analysis of colour variation that indicate different physiological states of the plant.

GREEN CHANNEL – Indicates chlorosis, a symptoms ofnutrient deficiency or pathogen infection.VISIBLE SPECTRUM : leafspots, browning, yellowing, and also used to identify the pathogen virulence,provide management to reduce the crop loss.

Internet of Things (IOT)

IOT is revolutionizing plant pathology by enabling real mean time data [RMTD] used to collect and gather for management of plant health across the large agricultural fields. Such as temperature, humidity, moisture.

Data – Driven decision making: pesticides,water usage in form of algorithms.

Precision agriculture: specific field treatment for epidemic area. Remote sensing – Using with robots and satellites to configured the disease symptoms and provide management practices to affected plants.

Drone – Aerial device used to identify the disease symptoms and capture through small mounted camera and used to spray pesticides, fungicides for large coverage of agriculture field. Provide sustainable yield with disease knowledge to farmers.

Conclusion

The adoption of these technologies enables more informed decision - making, resource optimization and the development of more resilient crops. Hence, these advanced tools provide the agricultural sector with the means to stay ahead, ensuring food security for future purpose and minimizing environmental impact. Overall, the future of plant pathology based on data driven and artificial intelligence technology paving the way for smarter, more sustainable farming practices.