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Survey of Plant Diseases in a Local Agro-Ecosystem and Their Management Practices

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ABSTRACT

One of the main factors influencing agricultural output and food security in regional agro-ecosystems is plant diseases. In order to identify prevalent plant diseases that occur in crop fields and to assess the management strategies used by farmers to reduce disease, a field study was carried out. Major crops like wheat, rice, tomatoes, potatoes, mustard, and pulses were grown in the sample agricultural area where the study was conducted. Field observations, farmer interviews, and disease incidence reporting were used to gather data. Leaf blight, powdery mildew, rust, wilt, damping-off, bacterial leaf spot, and mosaic virus infection were the main illnesses seen. Cereal crops were mostly impacted by fungal infections including rust and blight, although tomato and potato crops exhibited greater disease incidence due to favorable moisture and temperature conditions.While integrated disease management techniques including crop rotation, resistant cultivars, seed treatment, and field cleaning were less often used, farmers frequently used chemical fungicides and pesticides as the main control approach. The findings showed that the research area's agricultural output and quality were considerably lowered by disease incidence. In order to improve crop health, productivity, and environmental safety, the study stresses the necessity of integrated plant disease management and the significance of raising awareness of sustainable disease management practices.

KEYWORDS

Fungal, Bacterial, Viral, Integrated Disease Management, Crop Protection, Agro-Ecosystem, Disease Incidence, And Plant Disease Survey

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1. Introduction

One of the main biological limitations that lowers agricultural output and jeopardizes global food security is plant diseases. Crop development, production, and quality are greatly impacted by illnesses brought on by bacteria, viruses, nematodes, and fungus in local agro-ecosystems. In addition to lowering farmers' earnings, these illnesses upset the natural equilibrium of agricultural systems. The Food and Agriculture Organization (FAO) estimates that plant pests and diseases cause 20–40% of the world's crop production to be lost each year, resulting in significant financial losses and food shortages. Because of their ability to spread quickly and adapt to favorable climatic circumstances, fungal diseases are thought to be the most devastating of all plant diseases.

In Indian farming systems, common fungal diseases include rust in wheat, blast in rice, early blight in tomatoes, late blight in potatoes, wilt in chickpeas, and powdery mildew in vegetables are commonly observed.

According to Agrios (2005), because of their enormous capacity for reproduction and ability to survive in soil and plant detritus, fungus are the most common plant diseases impacting field crops. According to Savary et al. (2019), fungal pathogen-caused illnesses are responsible for the largest production losses in staple crops globally.

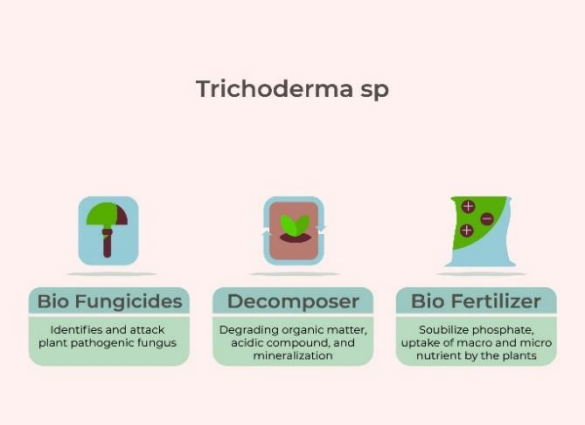
Disease development is significantly influenced by environmental conditions, including temperature, humidity, rainfall, irrigation, and cropping patterns. Fungal spore development and infection are favored by high humidity and extended leaf wetness. Disease incidence is also increased by monocropping, inadequate drainage, and excessive irrigation.

According to He et al. (2016), monoculture systems and agricultural intensification raise the possibility of plant disease outbreaks in agro-ecosystems.

The main factors influencing the severity of fungal diseases in field crops are temperature and humidity, according to Jain et al. (2019).

Chemical fungicides and pesticides are frequently used by farmers in local agricultural systems to control diseases since they yield immediate, noticeable results. On the other hand, overuse of agrochemicals causes soil degradation, pesticide resistance, environmental contamination, and the eradication of helpful microbes. According to Lamichhane et al. (2016), long-term crop protection cannot be achieved by relying just on chemical pesticides. Instead, to preserve the health of plants and soil, balanced and scientific management strategies are required.

Crop rotation, the use of resistant cultivars, seed treatment, field sanitation, biological management, and need-based chemical application are all included. According to Mundt (2002), resistant cultivars and cultivar combinations greatly slow the development of disease and the adaption of pathogens. Additionally, biological control agents like Pseudomonas and Trichoderma aid in enhancing soil fertility and lowering soil-borne illnesses.



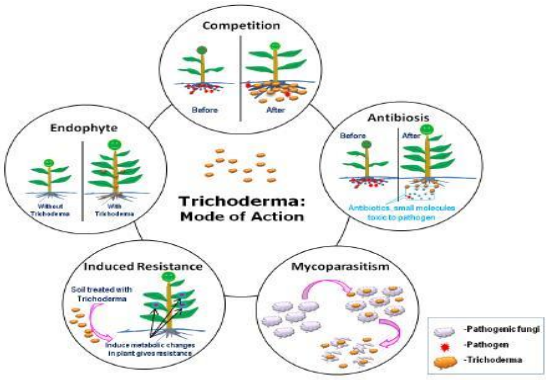
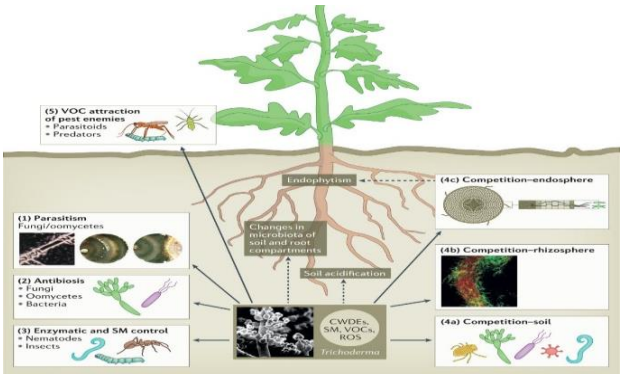


Figure 1. Model depicting mode of action of *Trichoderma* spp. against pathogen and plant growth improvement.

Early identification and disease forecasting have been enhanced by recent developments in plant disease diagnosis. Mobile advising systems, image-based disease diagnostics, and artificial intelligence are assisting farmers in promptly identifying symptoms and administering medication. AI-based plant disease detection systems greatly lower crop losses and increase diagnostic accuracy, according to Shafay et al. (2025).

In order to detect significant pathogens, comprehend the spread of diseases, and assess farmer management techniques, plant disease surveys in local agro-ecosystems are crucial.

Such surveys offer useful data for encouraging sustainable agriculture and creating disease management plans tailored to a particular area. In order to increase crop productivity and the health of the agro-ecosystem, the current study is to evaluate the main plant diseases in nearby crop fields and examine the management strategies used by farmers.



Methodologies

A local agricultural environment comprising crop fields from neighboring villages where seasonal crop production and mixed cropping were practiced was used for the survey. Major crops grown in the research region included wheat, rice, tomatoes, potatoes, mustard, chickpeas, and pigeon peas.

1. Choosing a Study Area

Based on crop diversification and disease incidence, five agricultural fields from various regions were chosen. Both rainfed and irrigated farming methods were represented by the chosen locations.

2. Observation and Field Survey

During the crop growing season, field visits were carried out on a regular basis. Yellowing, leaf spots, wilting, powdery growth, rust pustules, mosaic patterns, and stem rot were among the visible signs noted.

Figure 3. Field survey and sample collection process

3. Identification of Diseases

Samples of diseased plants were gathered and diagnosed using conventional plant pathology guides and visual signs. For confirmation, farmer observations were also taken into account.

4. Interview with Farmers

Farmers were interviewed in a structured manner to gather data on disease incidence, crop loss, pesticide use, seed treatment, resistant cultivars, and conventional management techniques.

5. Calculating Disease Incidence

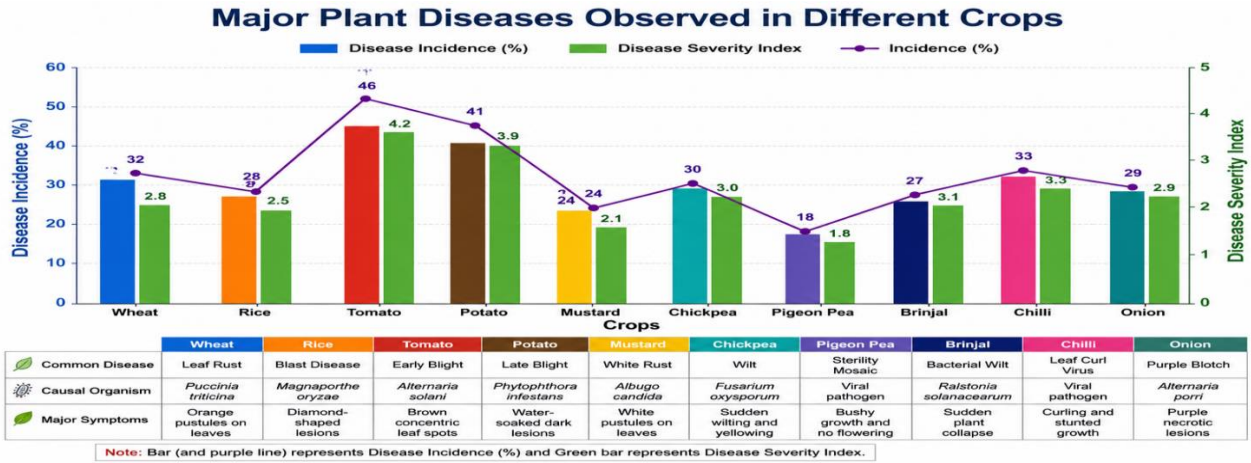
The following formula was used to determine the disease incidence:
Disease Incidence (%) is calculated by dividing the total number of plants observed by the number of infected plants by 100.

6. Analysis of Data

The percentage distribution and comparative evaluation of crop disease prevalence were used to tabulate and analyze the collected data.

Result and Discussion

According to the survey, bacterial and viral infections were the next most common plant health constraints in the local agro-ecosystem, after fungal diseases. Crop type, season, irrigation technique, and field sanitation level all had a substantial impact on disease prevalence. Due to constant monocropping, intense irrigation, and increased humidity surrounding the canopy, vegetable crops exhibited greater disease severity than cereal crops.Five survey locations yielded a total of 320 field observations from various crop fields. Of these observations, fungal diseases accounted for 61%, bacterial diseases for 21%, viral diseases for 13%, and nematode and mixed infections for 5%. The crops most susceptible to disease were found to be tomatoes, potatoes, and brinjal.

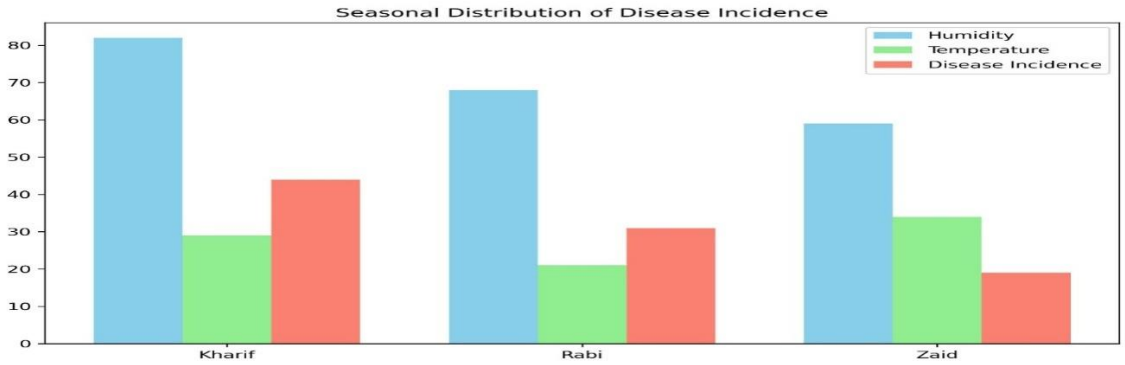


	Wheat	Rice	Tomato	Potato	Mustard	Chickpea	Pigeon Pea	Brinjal	Chilli	Onion
Common Disease	Leaf Rust	Blast Disease	Early Blight	Late Blight	White Rust	Wilt	Sterility Mosaic	Bacterial Wilt	Leaf Curl Virus	Purple Blotch
Causal Organism	*Puccinia triticina*	*Magnaporthe oryzae*	*Alternaria solani*	*Phytophthora infestans*	*Albugo candida*	*Fusarium oxysporum*	Viral pathogen	*Ralstonia solanacearum*	Viral pathogen	*Alternaria porri*
Major Symptoms	Orange pustules on leaves	Diamond-shaped lesions	Brown concentric leaf spots	Water-soaked dark lesions	White pustules on leaves	Sudden wilting and yellowing	Bushy growth and no flowering	Sudden plant collapse	Curling and stunted growth	Purple necrotic lesions

Note: Bar (and purple line) represents Disease Incidence (%) and Green bar represents Disease Severity Index.

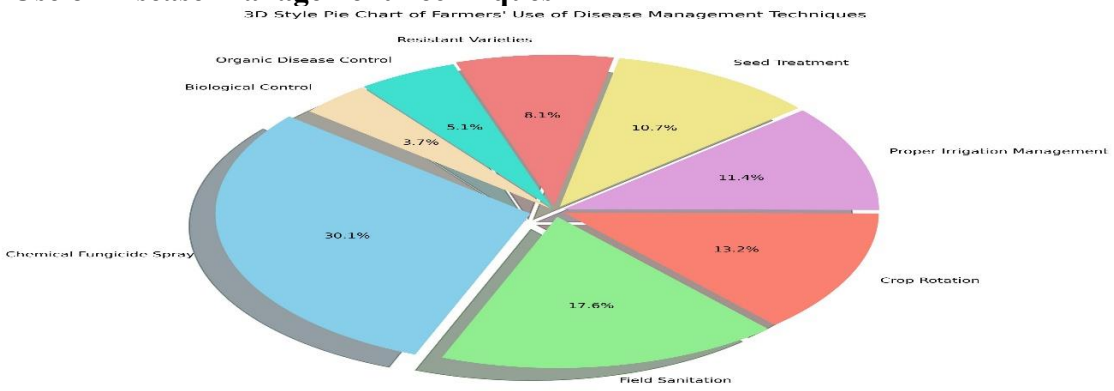
After potato late blight, tomato early blight had the highest disease incidence (46%) and disease severity index (4.2). Excessive wetness and constant cultivation had a significant negative impact on these crops.

Distribution of Disease Incidence by Season



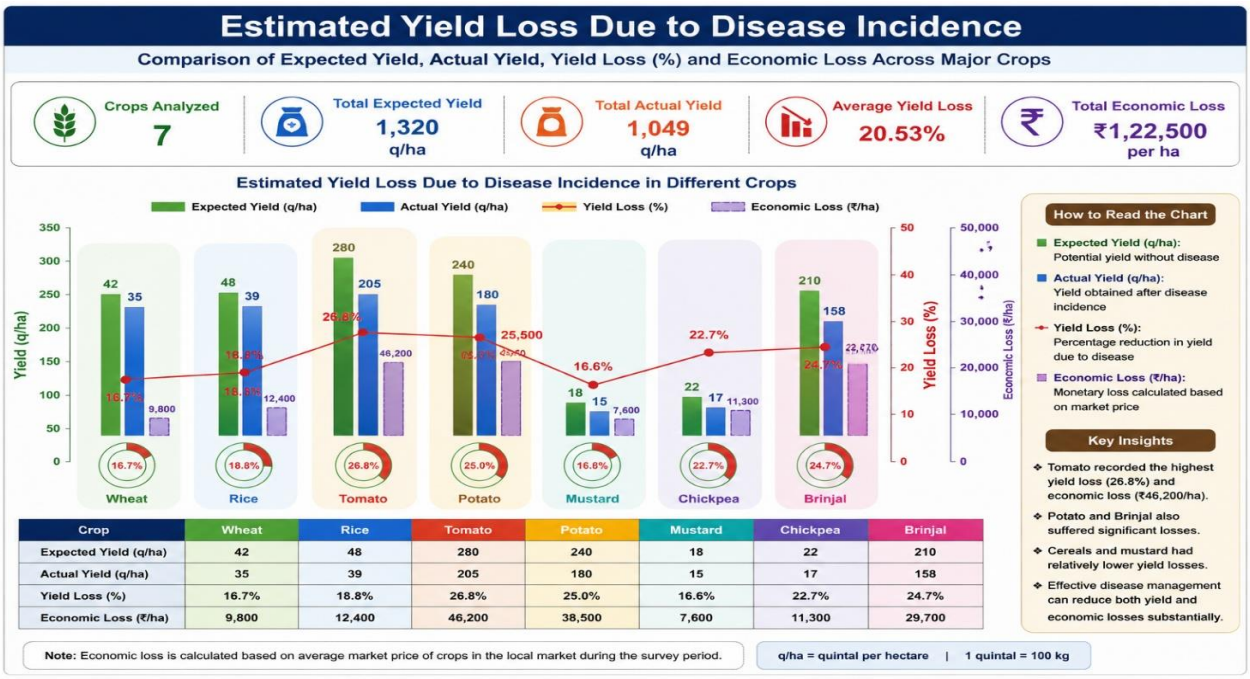
The excessive humidity and rains during the Kharif season, disease incidence was at its peak.Humidity and the development of disease were found to be strongly positively correlated. When humidity rose above 75%, fungal illnesses became much more prevalent.

Farmers' Use of Disease Management Techniques



Chemical fungicides were used extensively by most farmers due to their quick, noticeable effects. However, frequent use of pesticides raised input costs and had a detrimental impact on soil health. Due to inadequate awareness, the use of biological control techniques and resistant cultivars remained minimal.

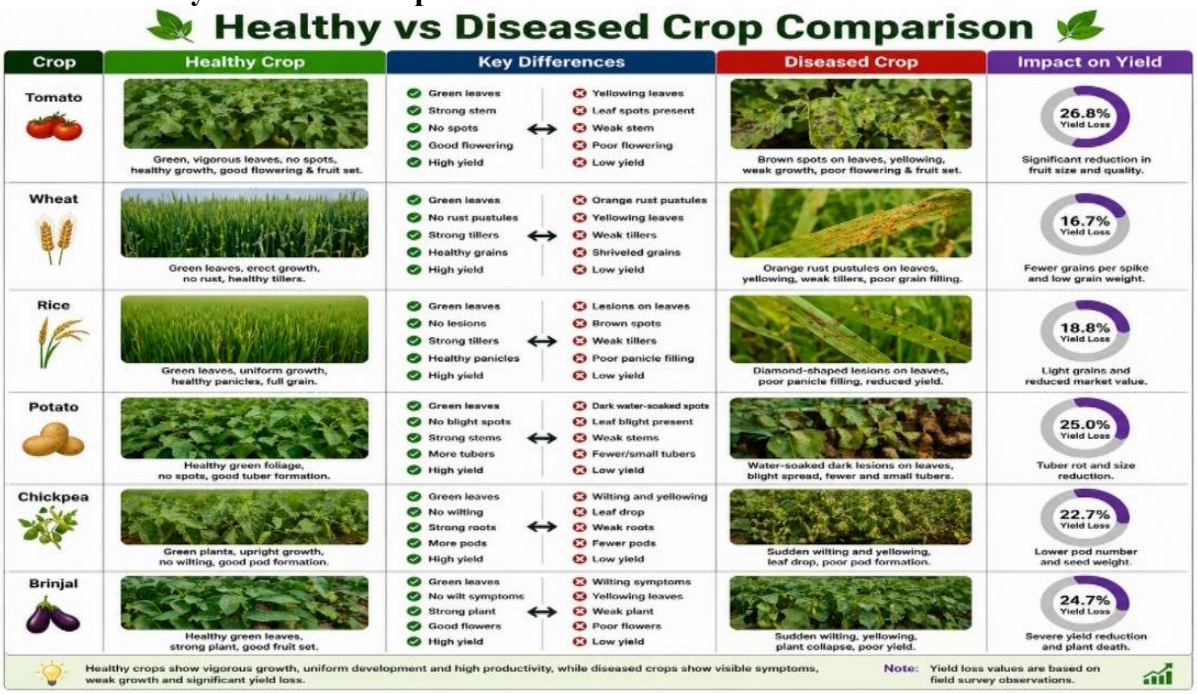
Disease Incidence-Related Estimated Yield Loss



Crop	Wheat	Rice	Tomato	Potato	Mustard	Chickpea	Brinjal
Expected Yield (q/ha)	42	48	280	240	18	22	210
Actual Yield (q/ha)	35	39	205	180	15	17	158
Yield Loss (%)	16.7%	18.8%	26.8%	25.0%	16.6%	22.7%	24.7%
Economic Loss (₹/ha)	9,800	12,400	46,200	38,500	7,600	11,300	29,700

Due to their higher market value and more severe disease progression, vegetable crops had a larger economic loss than cereals.

Comparison of healthy versus sick crops



The best sustainable strategy turned out to be Integrated Disease Management (IDM). Disease pressure can be considerably decreased by combining crop rotation, resistant varieties, seed treatment, sanitation, biological control, and need-based fungicide use.

Conclusion

Research Component	Major Findings	Impact on Agriculture	Recommended Management Strategy
Disease Prevalence	Fungal diseases were most	Reduced crop productivity and	Timely disease diagnosis and fungicidal management

	dominant, followed by bacterial and viral diseases	poor crop quality	
Highly Affected Crops	Tomato and potato showed maximum disease incidence	High yield loss and major economic damage	Resistant varieties and crop rotation
Cereal Crop Diseases	Wheat and rice were mainly affected by rust and blast diseases	Lower grain quality and reduced market value	Seed treatment and disease-resistant seeds
Disease-Promoting Factors	Poor sanitation, monocropping, excess irrigation, and poor drainage	Rapid disease spread and repeated infection	Proper field sanitation and irrigation management
Farmer Practices	Most farmers depended on chemical fungicides and pesticides	Increased production cost and environmental pollution	Need-based chemical use with expert guidance
IDM Adoption	Low use of crop rotation, biological control, and seed treatment	Long-term disease persistence and soil degradation	Promotion of Integrated Disease Management (IDM)
Economic Loss	Vegetable crops suffered higher yield and income losses	Financial instability among farmers	Sustainable crop protection strategies
Farmer Awareness	Limited knowledge of disease diagnosis and sustainable control	Financial instability among farmers	Farmer training and extension services

According to the report, one of the main factors lowering agricultural output in the local agro-ecosystem is plant diseases, particularly fungal infections. The most impacted crops were potatoes and tomatoes, while rust and blast diseases primarily damaged wheat and rice. While sustainable methods like crop rotation and seed treatment were less common, the majority of farmers relied on chemical fungicides. Enhancing crop health and guaranteeing sustainable agriculture depend on farmer awareness and Integrated Disease Management (IDM).

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