

Safeguarding Pulse Yields Under Changing Climate Scenario

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Introduction

Pulse diseases caused by pathogenic microorganism are becoming more frequent and severe under changing climatic conditions. Diseases such as wilt, root rot, powdery mildew, rust, anthracnose, and yellow mosaic disease are emerging as major threats in many pulse-growing regions worldwide. Warmer temperatures and prolonged moisture conditions often accelerate pathogen multiplication and disease spread, while drought stress weakens plant defense mechanisms, making crops more vulnerable to infection. In addition, the changing climate is influencing the distribution of insect vectors responsible for transmitting viral diseases, leading to the appearance of new disease outbreaks in previously unaffected areas. The interaction between climate factors and plant pathogens has also increased the unpredictability of disease occurrence. Sudden shifts in temperature and rainfall patterns can trigger epidemics that are difficult for farmers to anticipate and manage. Traditional disease management practices alone may no longer provide adequate protection under these rapidly changing environmental conditions. Therefore, there is a growing need for integrated disease management approaches that combine cultural, biological, mechanical, and chemical methods in a sustainable manner.

Adoption of climate-smart agricultural practices can play a significant role in reducing disease incidence in pulse crops. The use of disease-resistant and climate-resilient varieties is one of the most effective and economical strategies for minimizing crop losses. Timely sowing, crop rotation, balanced nutrient management, proper drainage, and field sanitation can further help in suppressing pathogen buildup. Seed treatment with fungicides or beneficial microbes and regular monitoring of disease symptoms are also essential components of effective disease management.

Biological control agents and eco-friendly plant protection measures are gaining importance in sustainable pulse cultivation. Beneficial microorganisms such as *Trichoderma*, *Pseudomonas*, and *Bacillus* species help suppress soil-borne pathogens and improve plant health. Similarly, the use of biopesticides and botanical extracts can reduce dependence on excessive chemical pesticides, thereby promoting environmental safety and long-term soil fertility. Precision farming tools, weather-based disease forecasting systems, and digital advisory services can further support

farmers in making timely management decisions. Strengthening research, farmer awareness, and extension services is crucial for building resilience against climate-induced diseases in pulses. Scientists, policymakers, and farming communities must work together to develop region-specific disease management strategies suited to local climatic conditions. Training programs and dissemination of improved technologies can empower farmers to respond effectively to emerging disease challenges. Through integrated and climate-resilient approaches, it is possible to safeguard pulse productivity, enhance nutritional security, and ensure sustainable agricultural development in the face of climate uncertainty.

How Climate Change Raises Disease Risks

Changes in climate patterns especially warmer temperatures and longer periods of high humidity are favoring the spread and survival of many crop diseases. Shifts in temperature and rainfall patterns directly impact how plant diseases develop and spread. Warmer temperatures and longer wet periods encourage the growth of fungi, bacteria, and viruses that attack pulse crops. Pathogens that were once limited to certain regions or seasons are now appearing earlier, lasting longer, and spreading more widely. Some of the most common and destructive diseases affecting pulse crops include:

- **Fusarium wilt** – causes wilting and yellowing, often leading to plant death (Figure 1)
- **Ascochyta blight** – creates dark lesions on stems and leaves, reducing yield
- **Rust** – results in reddish-brown pustules on leaves, weakening the plant
- **Powdery mildew** – leaves a white coating on leaves and pods, hampering photosynthesis
- **Yellow Mosaic Virus (YMV)** – causes yellowing and curling of leaves, reducing pod formation (Figure 1)

These diseases are spreading faster and appearing in new areas, making conventional control measures less effective.

Practical Strategies for Managing Diseases in Pulse Crops

To manage these growing risks, farmers and agricultural experts are turning to integrated approaches that combine preventive practices, biological tools, and smart crop management.

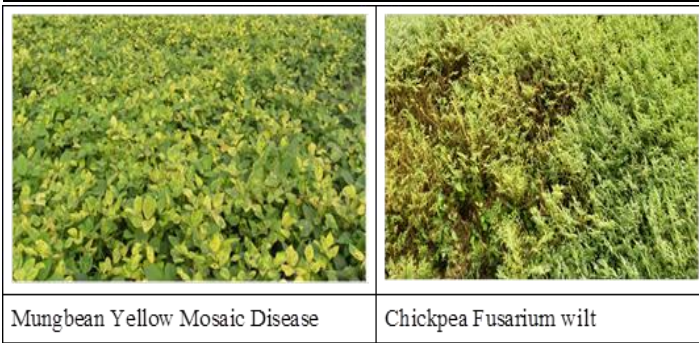


Fig.1. Disease symptom in crop plants

1. Use of Climate-Resilient and Disease-Resistant Varieties

Planting disease-resistant and climate-tolerant pulse varieties is one of the most reliable ways to reduce crop loss. These varieties are carefully developed through breeding programs and are capable of withstanding common pathogens as well as environmental stress such as drought or excessive rainfall.

2. Integrated Disease Management (IDM)

IDM combines several practices to manage diseases sustainably and reduce the overuse of chemical pesticides.

a. Crop Rotation and Intercropping

Avoid planting the same pulse crop in the same field every season. Rotating with cereals or oilseeds disrupts disease cycles. Intercropping pulses with crops like maize or sorghum can reduce disease pressure by limiting the spread of pathogens.

b. Proper Field Management

- Sow seeds at the recommended time to avoid peak disease periods
- Use certified, disease-free seeds
- Maintain proper field drainage to prevent waterlogging
- Remove and destroy infected plant residues after harvest

c. Seed and Soil Treatments

Treating seeds with bio-fungicides like *Trichoderma* or *Pseudomonas* can protect young plants from early infections. Soil amendments may also reduce disease-causing organisms before planting begins.

d. Judicious Use of Fungicides

Use fungicides only when needed, following local guidelines. Avoid repeated use of the same product to prevent resistance. Rotate between different types of fungicides for long-term effectiveness.

e. Biological Control Methods

Biological control involves the use of beneficial microorganisms to suppress plant pathogens and enhance

crop health in an eco-friendly manner. Microbial agents such as *Bacillus subtilis*, *Pseudomonas fluorescens*, and *Trichoderma* species are widely used for managing several soil-borne and foliar diseases in pulse crops. These beneficial microbes inhibit pathogen growth through competition, antibiosis, parasitism, and induction of plant defense responses. Application of biocontrol agents through seed treatment, soil application, or foliar spray helps reduce disease incidence while improving plant vigor and root health. Unlike excessive chemical pesticide use, biological control methods are environmentally safe, support soil microbial diversity, and minimize the risk of pathogen resistance development. Integrating biological control with other disease management practices can provide sustainable and long-term protection for pulse crops under changing climate conditions.

3. Monitoring, Forecasting, and Early Detection

Regular field monitoring allows early detection of disease symptoms before they spread across a crop. In addition, weather-based forecasting tools can predict when conditions are right for disease outbreaks based on local data (temperature, humidity, and rainfall). These alerts help farmers take timely preventive actions.

4. Training and Farmer Awareness

Farmer education is critical to effective disease management. Training programs help farmers:

- Identify early symptoms of major pulse diseases.
- Apply pesticides safely and correctly.
- Adopt best practices for field hygiene and crop care

Workshops, printed materials, and field demonstrations all support informed decision-making. Extension officers play a key role in delivering up-to-date, location-specific advice.

Conclusion

Managing plant diseases in pulse crops is becoming increasingly challenging under changing climate conditions. Rising temperatures, erratic rainfall, and increased humidity are creating favorable environments for the development and spread of many destructive pathogens. Nevertheless, the adoption of timely and integrated disease management strategies can significantly reduce crop losses and improve resilience in pulse production systems. The use of disease-resistant and climate-resilient varieties, crop rotation, balanced nutrient management, proper field sanitation, and judicious use of pesticides and biological control agents are essential measures for sustainable disease management. In addition, regular disease monitoring, weather-based forecasting systems, and farmer awareness programs can help in taking timely preventive actions against emerging disease

threats. Pulse crops are vital for nutritional security, soil fertility enhancement, and sustainable agriculture. Therefore, protecting pulses from climate-induced diseases is not only important for maintaining crop productivity but also for ensuring food security and improving farmers'

livelihoods. Strengthening research, extension support, and climate-smart agricultural practices will play a crucial role in safeguarding pulse yields and securing resilient farming systems for the future.