

Management of Major Diseases of Vegetable Seed Crops Identified in NPPRC Laboratory

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Abstract

Area under vegetable cultivation is increasing in Nepal; however, the farmers are unable to meet the demand of vegetables particularly in urban areas. With the increasing market demand even seed production has become increasingly challenging for farmers. Vegetable seed production is critical to agricultural sustainability and food security. Nevertheless, seed crops are highly susceptible to several diseases that threaten seed quality and yield. The area under vegetable seed crops, along with overall production and productivity, has been increasing steadily. Based on received and identified samples at the National Plant Pathology Research Centre (NPPRC), laboratory diagnostics have identified key pathogens affecting disease caused by fungus, bacteria, viruses and nematode. The identified samples in vegetables consisting fungal diseases with 70% were root rot, alternaria leaf spot, downy and powdery mildew, early and late blight, and anthracnose. Similarly, with 8% were bacterial wilt, bacterial stem rot, bacterial canker, black rot, and pith necrosis. In viral diseases with 16% were cucumber mosaic virus, tomato mosaic virus, tomato leaf curl virus, potyvirus zucchini yellow mosaic virus and 6% by nematodes. So, early detection with an effective management practice is most necessary to ensure the production of high-quality, disease-free vegetable seeds.

Keywords: Diagnosis, Disease, Horticultural crops, Identification, Vegetable seed

Introduction

Ensuring the availability of high-quality vegetables seed however; seed-borne and seed-transmitted diseases pose a significant threat to both seed quality and crop productivity caused by fungi, bacteria, viruses, and nematodes. The National Plant Pathology Research Centre (NPPRC) plays a vital role in identifying and diagnosing major diseases affecting vegetable seed crops through laboratory-based investigations. It not only ensures a good yield of healthy seeds but also contributes to sustainable agricultural practices by preventing the spread of diseases. It has a significant impact on seeds, often exhibiting poor germination rates, weak seedlings, and reduced vigour, all of which can affect crop performance and overall productivity. The economic impact of vegetables diseases leads to significant economic losses by reducing both seed yield and quality, leading to higher production costs and lower marketability and environmental health. This can be managed by using disease free seeds and seed treatments. In order to combat these challenges, integrated disease management is essential. This includes practices like using resistant varieties bred to tolerate or resist specific pathogens, crop rotation of vegetable seed crops with non-host plants to reduce the build-up of soil-borne diseases, and field sanitation practices. Cultural practices such as removing infected plant debris, proper spacing, timely planting, appropriate fertilization, cleaning tools, and avoiding excessive irrigation can also prevent the spread of diseases. The application of proper chemical and biological fungicides and pesticides within an integrated pest management framework, along with seed treatments using fungicides, bactericides, and other biological agents before planting, can reduce the risk of seed-borne diseases and improve germination and seedling establishment. Regular monitoring of fields by surveillance for early disease symptoms can help identify and control outbreaks before they spread significantly. A combination of these all strategies can significantly reduce disease incidence and enhance the resilience of seed crops. By implementing integrated disease management strategies, farmers can ensure healthy crops, quality seeds, and long-term agricultural success. Effective disease management practices can reduce reliance on chemical treatments, maintain high-quality seed production, optimize yields, minimize their impact on the environment and human health, and ensure the sustainability of farming practices. Diagnosis is one of the most important aspects for the proper identification of the disease and its causal agents to apply any measures for disease management. Proper disease diagnosis is therefore vital.

Materials and Methods

National Plant Pathology Research Centre (NPPRC) laboratory identify major diseases affecting vegetable seed crops and evaluate effective management practices through sample collection seed health testing by blotter, agar plate, growing seed for 3-4 weeks, pathogen identification morphological and molecular, and assessment of integrated disease management techniques. The samples of different vegetables such as; tomato, potato, chilly, capsicum, pumpkin, chayote, gourds, cauliflower, cabbage, broccoli, radish, carrot, mustard, ginger, garlic, and onion from various locations were received from surveys, field visits, and stakeholders for diagnosis and advisory services. The main objectives of this center are accurately identifying diseases, determining causative agents, assessing disease severity, and understanding the spread of diseases under conducive environmental factors. By contributing to scientific research on new diseases, their causes, and their impact, NPPRC provides good recommendations with education and awareness about the diseases, their symptoms, causes, and management strategies. For accurate disease diagnosis and proper identification, various activities were carried out. This included gathering information about the crop's history regarding field distribution, year of cultivation, variety, previous crop, weather conditions, time of disease appearance, soil type, and use of organic and inorganic manures and pesticides. The samples were labeled with the crop name, location, and date of collection, handled gently, and kept out of the sun, preferably in a cooler area. With the signs and symptoms of the collected samples were studied along with the incidence and severity levels of diseases. Visual inspection was conducted initially, followed by incubation in a moist chamber, agar plate tests using selective media, and molecular testing. Consultations with literature, internet searches, and images were used to finalize proper management practices. Suspected disease samples were checked for their distribution pattern, i.e., localized or systemic. The samples were categorized as fungal, bacterial, viral, nematode, or others based on visual signs and symptoms. The ooze test is one common practice for bacterial disease testing. Common symptoms include leaf blight, wilt, anthracnose, scab, mosaic, and leaf curl, while mildew, mold, smut, rust, and sclerotonia are common signs for diagnosing diseases (Manandhar and Amatya, 1992). For fungal diseases, methods like direct inspection, washing tests, blotter tests, agar and selective media plate tests, and seedling tests were used. For bacterial diseases, morphological, biochemical, pathogenicity, hypersensitive, and serological tests were applied (Manandhar and Amatya, 1992). Viral diseases were identified using dry seed inspection, seedling growing tests, indicator plant tests, and serological tests. Plant parasitic nematodes were characterized using extraction and morphological identification methods.

Observations were compared with visual color pictures from the internet and crop compendiums for diagnosis (Barnett and Hunter, 1972). The first step upon returning to the laboratory was to keep diseased tissue in a moist chamber to induce sporulation. This could involve placing the sample in a sterile petri dish with wet filter paper and a glass tubing triangle to expose it to humid conditions (Mathur and Kongsdal, 2003). Methods like washing tests in Tween 20, sodium hydroxide soaking, and blotter methods were employed for detecting seed-borne fungi. Laboratory equipment such as sterile petri dishes, incubators, autoclaves, laminar flow hoods, microscopes, seed germination trays, biosafety cabinets, and refrigerators/freezers was essential for pathogen analysis and seed testing done for disease identification.

Results

National Plant Pathology Research Centre (NPPRC) laboratory identify plant disease every fiscal year. 50 % are vegetables. Among them, 70% of samples were infected by fungus, 8% bacterial, 16% viral and 6% by nematodes. Those samples were either collected during surveys and field visits or received from different stakeholders for diagnosis and advisory services with detailed information for accurate disease diagnosis and proper identification in figure 1.

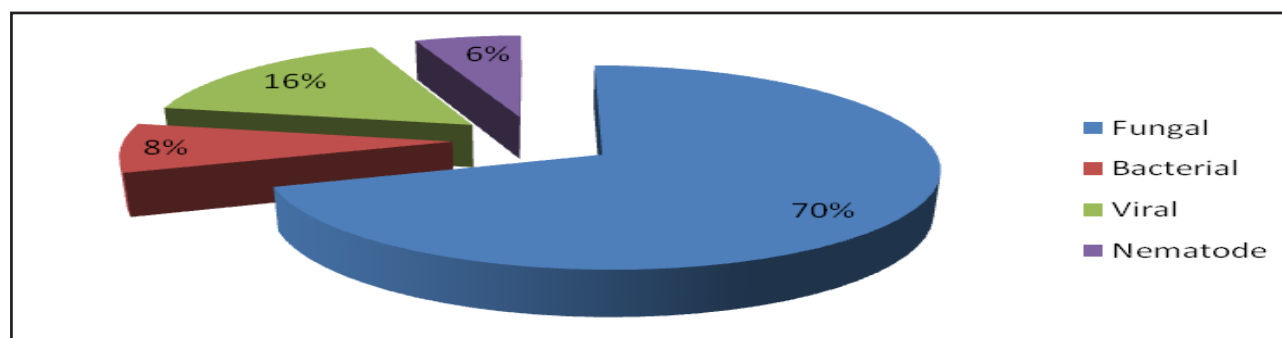


Figure 1: Frequency of major diseases identified every fiscal year

The major diseases identified from different vegetables that NPPRC laboratory received regularly. Vegetable diseases sample having the potential to infect germinating seedlings, leading to disease outbreaks in plant populations under suitable moisture and temperature conditions. Out of received and identified diseases sample 48% solanaceous crop with the pathogen *Fusarium* sp., *Alternaria solani*, *Phytophthora infestans*, *Leveillula taurice*, *Collectotrichum* sp., *Spongospora subterranean*, *Erwinia carotovora*, *Ralstonia solanacearum*. 16% of cucurbits crop with the pathogen *Pseudoperonospora cubensis*, *Colletotrichum* spp, *Didymella bryoniae* 14% of crucifers crop with the pathogen *Alternaria brassicicola*, *Peronospora parasitica*, *Xanthomonas compestris* pv *campestris*, 18% of cole crops with the pathogen *Botrytis* sp., *Phoma* sp., *Alternaria* sp., *Stemphylium* sp. and rest were other crops received from different locations of Lalitpur, Bhaktapur, Dolakha, Kanchanpur, Siraha, Banke, Kavrepalanchowk, Sarlahi, Kaski, Kathmandu, Kavre palanchowk, Gulmi, Panchthar, Dhading, Rautahat, Gorkha, Sindhupalchowk, Jhapa, Chitwan, Bara, and Nuwakot districts for accurate disease diagnosis and proper identification shown in figure 2.

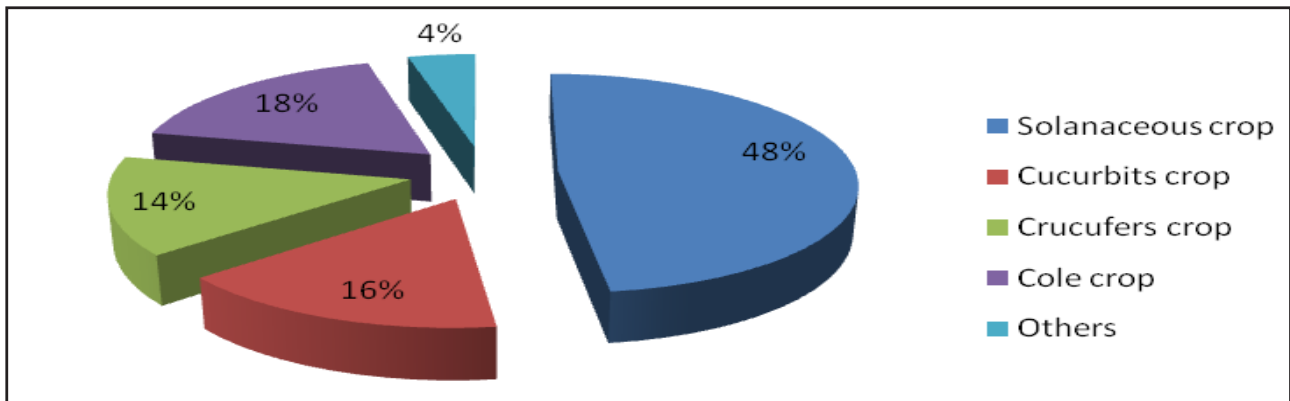


Figure 2: Frequency of major crop identified every fiscal year

Discussion

The results of this study highlight the significant threat posed by seed-borne pathogens to vegetable seed quality and viability. Vegetable seed crops are vulnerable to a wide range of diseases caused by fungi, bacteria, viruses, and nematodes. Disease management strategies are crucial since the health and quality of seeds directly impact the next generation of crops. Seed-borne diseases can spread quickly, affecting entire growing seasons and leading to significant yield and economic losses. The production of vegetable seed crops requires specialized measures, ensuring disease-free seed production is therefore a priority for farmers, seed companies, and regulatory agencies. Fungi, being the predominant group, constitute the largest number of plant pathogens and are responsible for a range of serious plant diseases. Similarly, viral, bacterial, and nematode diseases are also responsible so far. Nematodes, though constituting a smaller proportion, can inflict substantial damage through their feeding activities on plant roots, leading to reduced nutrient uptake and compromised yield (Hansen and Wick, 1993). The importance of managing seed-borne diseases lies in their transmission, the demand for healthy seeds in the market, and their impact on yield and quality. Phytosanitary regulations to prevent the import and export of infected seeds should impose strict measures to ensure sustainable production, reduce yield losses, and maintain crop quality. Based on our findings, recommendations for disease management strategies should therefore be provided, making the management of these diseases an essential task for all producers.

In terms of percentage, 70% of samples were infected by fungi, 8% by bacteria, 16% by viruses, and 6% by nematodes. It shows that vegetable disease crops are on an increasing trend. Based on the identification in the NPPRC laboratory, solanaceous crops, followed by cucurbits and cruciferous crops, were found to be the major problems in vegetable. The identification of some fungal diseases occur on a wide range of vegetables, which include anthracnose, botrytis rots, downy and powdery mildews, fusarium, rhizoctonia, sclerotium rots, and rust. Though fungal diseases are predominant, the viruses, while less prevalent, can have significant economic impacts due to their ability to spread rapidly and cause severe symptoms such as leaf curl and roll, mosaic patterns, and stunted growth. Bacterial pathogens, though less common, are notorious for causing diseases like bacterial wilt, stem rot, pith necrosis, and leaf spot, often necessitating integrated control measures. These predominant pathogens align with findings from similar agro-climatic regions, indicating a widespread prevalence of these organisms in vegetable seed systems. Accurate diagnosis is crucial to the development of an effective control program encompassing a wide array of species causing various plant diseases, ranging from root rots and fruit rots to foliar blights. This category encompasses a diverse range of hosts not included in the specified categories, indicating that diseases are prevalent across various agricultural sectors (Riley et al., 2002). They cause both qualitative and quantitative losses of crop

yield every year. Direct losses are caused by both quantitative and qualitative yield reductions, while indirect losses result from control measures and quarantine status. Diagnosis activities were carried out with the objectives of determining the distribution of diseases in the country, exploring new disease outbreaks and their epidemiology, and providing information for disease management and research area prioritization. These activities help in understanding the distribution of diseases in the country, exploring new disease outbreaks and their epidemiology, and providing valuable information for disease management. Discussing the potential impact of these diseases on plant health and agricultural practices is vital. Additionally, it is important to discuss the strengths and limitations of each diagnostic technique used. These efforts will help farmers detecting diseases early and managing them properly. Identifying specific pathogens and understanding how they relate to the observed symptoms in plants is significant, as major vegetable seed crop diseases can develop quickly and cause losses if not managed.

Conclusion

Continued survey should be done due to change in pathogen diversity which may be caused by selection pressure due to changes in the cropping system introducing new genotypes, and climate change. The findings emphasize the coordination and collaboration with national and international organizations is must for the early detection, regular seed health monitoring, and the adoption of integrated, crop-specific disease management approaches to ensure the production and distribution of high-quality, disease-free vegetable seeds for addressing the challenges of pathogen persistence.

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