International Journal of Modern Agriculture, Volume 10, No.2, 2021
ISSN: 2305-7246

Disease Management of Vegetables

Yogesh Kumar K[1], Benaka Prasad SB [2]

[1] Department of Chemistry, Faculty of Engineering and Technology, Jain (Deemed-to-be University), Karnataka
Email - k.yogeshkumar@jainuniversity.ac.in

Abstract

Mostly people follow vegetarian diet from the ages but due to various disease in vegetables creates a heavy loss to a person in many ways. India ranks first in the world, with vegetarians accounting for 38% of the population. For any vegetable growth, disease can occur at any stage of life cycle whether it will be a pre-harvest or post-harvest disease. Vegetables should be protected throughout their life cycle to enjoy a better taste with nutrition. The four major pathogens behind the disease in vegetables are bacteria, fungus, virus, and nematodes. Till now remote farmers are still using traditional method to tackle with the vegetable diseases. To safeguard the vegetable, it is necessary to distinguish the disease early any carry-out the treatment procedure. There is a utilization of pesticides and chemicals to make vegetable free of diseases. To make vegetables disease free without the use of chemicals and pesticides a practice of integrated method over the world should be practiced. In future, it can be used for organic plants to manage all the disease caused by pathogens and also manage with cost so that it can be applicable for all the remote farmers also.

Keywords: Crop, Disease, Management, Pathogens, Plants, Symptoms, Vegetables.

Introduction

India is the world's leading vegetarian nation, with vegetarians accounting for 38% of the population. Following the arrival of Buddhism and Jainism in the 6th century BC, vegetarianism became widespread in the region[1]. During plant growth, diseases may occur at any stage. To protect the plant, it is essential to diagnose the cause of the disease quickly and to carry out fast treatment. Some life-borne infectious diseases, microscopic organisms, may rapidly ruin a crop. However, these diseases are not so numerous for any vegetable, and therefore it wouldn't be hard for a grower to familiarize himself with them and to act appropriately. Inactive diseases (i.e. non-communicable) are harder to diagnose. Infectious agents are generally more easily eliminated as the reason of disorder before probable (inert) bases are investigated. This will highlights the requirement for the farmer to familiarize himself for the most general infectious disease on the crops[2].

Disease in plants develop heavy losses to an individual in many ways. Hunger and eradication of families bring about on or after the Irish scarcity initiated by late blight of potato and the pathogen behind it was Phytophthora infestans. There is a loss in valued resource with virtual removal of the chestnut blight diseases from American chestnuts which is affected by Cryphonectria-parasitica, and immediatiate financial damage like the predictable 1 billion dollar mislaid in a year to corn farmers belongs to America from southern corn leaf blight disease with their causative agents- Bipolaris maydis and Cochliobolus maydis. Several vegetable disease create less affected damages yearly all through the world however jointly organize substantial depletion to growers and decrease the artistic prices of land vegetation and home-grown grounds[3].

The result of relations among the disease mediator, the host, and its surroundings cause disease. If the reason behind the communicable disease is next to the moderator then not anything will occur if environmental aspects are conducive to contagion and plant growth. Usually, with leafage infectious agents, leaf moisture is required for the stimulation of spore germination and infection. Infection occurs with great moisture in soil and some serious temperatures of soil in combination with certain soil pathogens. Knowing the environmental drivers of the most important vegetable diseases offers an opportunity to be better managed: a disease may be prevented by changing some of the environmental drivers or steps can be made to limit its impact when these factors cannot be changed (e.g. fungicide can be functional in progress of a term of constant rainfall which will favour leafage diseases)[2].

The main objective behind disease management in vegetables is to decrease the economic and visual damage originates from plant disease. Conventionally, it is called as plant disease control, then existing communal and ecological standards suppose “switch” as being universal and the duration too inelastic. However, this change in mind-set has resulted in the emergence of other multidimensional methods to disorder controlling and combined disease managing. Soil fumigation, burning, and pesticide uses are not any more used as single, often harsh, steps. Furthermore, rather than following a schedule or a prescription, disease control procedures are often dictated by disease forecasting or disease modelling. Although it is often problematic to discriminate among the distinct two terms, mostly in the implementation of specific steps, disease management can be thought by means of active while disease regulator is sensitive[3]. Anticipating the outbreak of diseases and targeting susceptible facts in the cycle of disease are the cornerstones of plant disease management (i.e., feeble relations in the contamination fetter). As a result, accurate disease diagnosis is required in order to recognize the disease causing organisms’, which is the true goal of some disease supervision programme[2][4].

Pathogenic species do not cause all diseases. Identifying even if a disease is produced by a infectious agents or inactive (abiotic) reasons necessitates for not simply examining separate vegetables, but then mentioning down the symptom configuration in a region. Look for irregular symptoms including wilts, stunting, leaf spots, misshapen leaves, fruit rots, stem blight and cankers on individual vegetables. Galls, root rot, and necrosis should all be tested on the roots (lifeless zones). Arenas must be studied to see whether the difficulties are extensive and whether diverse plant types in and round the arena are influenced, as this may specify an abiotic reason. Within an area, physiological and nutritional symptoms are more common than infectious diseases[3].

Primarily, pathogens that are responsible for the many diseases will be separated in the regions and extent out from those zones. Similarly, wildflowers or un-associated harvest is not naturally concerned. Soil carrying pathogens are even further constrained inside an arena than foliar pathogens but from the Figure 1, illustrates all the different types of disease causing pathogens in vegetables that are mostly fungus, bacteria, virus, and nematode.

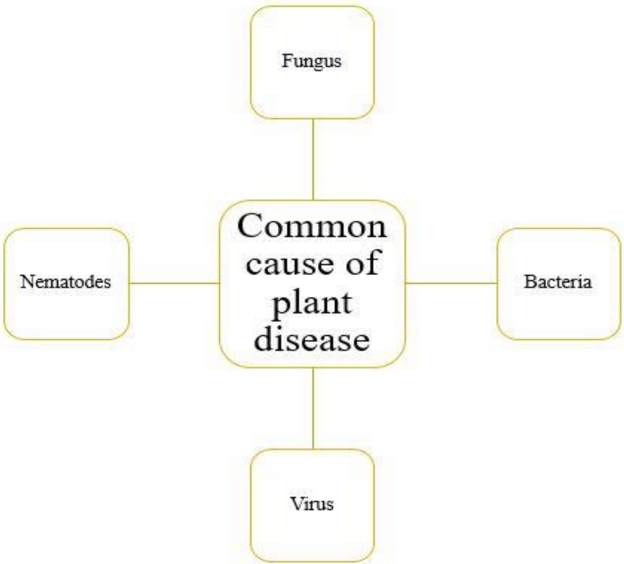

Figure 1: All Different Types of Disease-Causing Pathogens in Vegetables

1.1. Types of Disease Causing Pathogens in Vegetables:

1.1.1. Fungi:

A multicellular tiny entities which can expand into filamentous strands to reach their food. Their growth pattern is radial, so the results of their development can be understood as circular blot on surfaces like plant leaves. Other plant sections, such as roots, can, however, be infected with fungus and produce no visible structures. These infections can cause a variety of symptoms. Burning of the water-transferring tissue of the stalk, for example, in grouping by wilt, may imply infection known as Fusarium wilt. Extra disease indications, like blight (tissue demise), that can be caused by a number of things, can necessitate laboratory testing to rule out fungi as a cause. Powdery mildew fungus that require only greater humidity to start disease, numerous fungus that cause infection in leaves require free moisture for the initiation of disease.

1.1.2. Bacteria:

Bacteria are microscopic single-celled organisms that go dormant to survive. The infectious agents that produces general layer on potatoes, multicelled bacterium, filamentous, that develops spores which is a reproductive structure, is the most notable exception to this rule. Wind-directed rainfall, insect, or the drive of diseased plant pieces, such as seeds, can all transport them. Bacterial species that contaminate leaves can originates circular spot, then bacterial infections are more likely to cause irregularly shaped lesions that don't spread beyond veins. Soft rots of vegetative sections may also occur, and are typically accompanied through a rotten odour. Additional bacterial infection that cause indications like wilts necessitate research laboratory testing to be diagnosed.

1.1.3. Viruses:

Virus is microscopic species that only reproduce in the existing plant cells. Insects, for example, are required to transfer them to plants. A mosaic pattern on leaves is a common virus symptom, but viruses can also originate additional signs including stunting and necrotic lesions, that can be caused by another factors. Viruses are transmitted by insects such as leafhoppers, aphids, thrips, and white flies. Viruses can infect an extensive variety of vegetables, comprises weeds which aren't botanically connected to the crops, and indications aren't often visible in these plants.

1.1.4. Nematodes:

Microscopic roundworms that feed on plant roots are known as nematodes. On a wide variety of crops, the cause of root-galls and distorted roots is root-knot nematode. Plants that are heavily infested will wilt and die. Stubbiness, necrosis, and root stunting may all be caused by nematodes, but these signs aren't always obvious. To confirm the diagnosis, a soil or root analysis is needed[3].

1.2. Environmental Factors Affecting Plant Pathogens

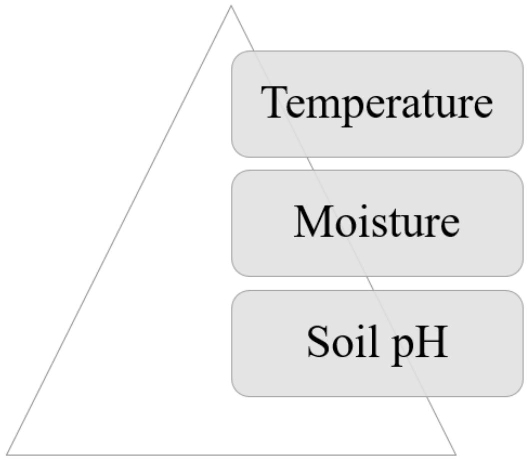

Figure 2: Different Environmental Factors on Which a Plant Pathogens Depend

From the Figure 2, various types of environmental factors on which a pathogen rely are- temperature of the soil, moisture and pH of the soil.

1.2.1. Temperature:

Suboptimal soil temperatures for germination of seed and growth of seedling can encourage the growth of damping off pathogens including Pythium and Rhizoctonia. Delaying planting before the soil temperature rises may also reduce the effect of these pathogens. The optimum temperature for the production of foliar pathogens varies. At high temperatures, bacterial disease symptoms on leaves are produced, and disease originated from fungus such as downy mildew may be stopped. Many diseases have temperature needs, which can be utilizes to precisely spread on fungicides once they are desired, such as late blight of potatoes.

1.2.2. Moisture:

Foliar diseases are exacerbated by moisture. Many bacteria and fungi need free moisture on the plant surface to grow and infect. There is typically a time limit that must be met. Moisture can also affect fungi's spore formation. This characteristic serves as the base for a predictive framework for fungicide selection in the treatment of onion purple blotch. Saturated soil moisture conditions may allow root rotting infectious agents like fungi types or Pythium that originate fruit-rot to thrive.

1.2.3. Soil pH:

The behaviour of certain soil-borne pathogens is influenced by soil pH. Cotton root rot diseases are more common in high pH soils, although Fusarium wilt infection are more general in acidic soil. In acidic soils, the development of the widespread potato layer pathogen is inhibited. However, adjusting the pH of the soil to control disease is typically not possible.

1.3. Disease Control Methods

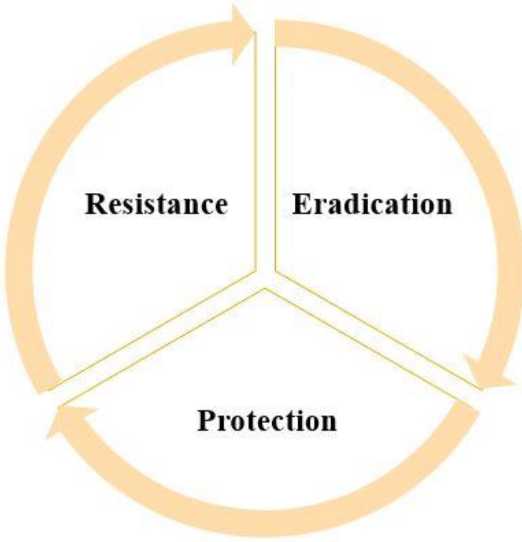

Figure 3: Traditional Method to Control Any Disease in Plants-Resistance, Eradication and Protection

From the Figure 3, the conventional method to control disease transmission in plants are discussed that are-

1.3.1. Resistance:

Plants have a number of biochemical and structural defence mechanisms to keep them healthy from infection. Some of these pathways are triggered before the infectious agents arrives (constitutive conflict), although others are triggered only after contamination (i.e. facilitated conflict)[5].

1.3.2. Eradication:

It is the process to eliminate an infectious agents after it has been administrated to an environment but earlier to its development by itself or spread extensively. It may remain used for separate plants, fields, seed lots, or region, then it is rarely successful above big regions.

1.3.3. Protection:

The moderator plant, the susceptible area pf moderator plant, or the infectious agents and the moderator plant must be isolated using this concept. Fungicide, bactericide, or nematicide, is the most common form of chemical barrier, but it also be a spatial, temporal barrier, or physical. Pathogens are existed, and contamination will happen deprived of the use of preventive methods, according to the specific techniques used[3]. Few examples of diseases are represented in Table 1 below.

Table 1: Some of the Disease Associated to Vegetables with Their Causative Pathogens

VEGETABLES	PATHOGENS	DISEASE
Tomato	*Botrytis cinerea*	Gray mold
	Fulvia fulva	Leaf mold
	Phytophthora infestans	Late blight

	Ralstonia solanacearum	Bacterial wilt
	Verticillium dahliae	Verticillium wilt
	Fusarium oxysporum f. sp. *radicis-lycopersici*	Root and Crown rot
Egg plant	*Sclerotinia sclerotiorum*	Sclerotinia stem rot
	Botrytis cinerea	Gray mold
	Sphaerotheca fuliginea/*Oidium* sp./*Oidiopsis sicula*	Powdery mildew
Bell pepper	*Ralstonia solanacearum*	Bacterial wilt
	Oidiopsis sicula	Powdery mildew
	Phytophthora capsici	Phytophthora blight
Cucumber	*Fusarium oxysporum* f. sp. *cucumerinum*	Fusarium wilt
	Pseudomonas syringae pv. *lachrymans*	Bacterial spot/Angular leaf spot
	Cladosporium cucumerinum	Scab
	Phytophthora melonis/*P. nicotianae*	Phytophthora rot
	Pseudoperonospora cubensis	Downy mildew
Melon	*Monosporascus cannonballus*	Monosporascus root rot
	Didymella bryoniae	Gummy stem blight
	Pseudoperonospora cubensis	Downy mildew
Strawberry	*Colletotrichum acutatum*/*C. fragariae*/*Glomerella cingulata*	Anthracnose / Crown rot
	Sphaerotheca humuli	Powdery mildew
	Fusarium oxysporum f. sp. *fragariae*	Fusarium wilt
Sweet potato	*Fusarium oxysporum*	Fusarium Wilt
	Ceratocystis fimbriata	Black Rot
	Sclerotium rolfsii	Southern Blight
Cabbage	*Erysiphe cruciferarum*	Powdery Mildew
	Alternaria brassicicola	Alternaria leafspot
	Peronospora parasitica	Downy Mildew
Potato	*Albugo candida*	White Rust

	Phytophthora infestans	Late Blight
	Alternaria solani	Early Blight
Onion	*Botrytis squamosa*	Botrytis Leaf Blight
	Alternaria porri	Purple Blotch
Spinach	*Cercospora beticola*	Fungal leafspots
	Peronospora farinosa f. sp. spinaciae	Downy Mildew
Pea	*Sclerotium rolfsii*	Southern Blight
	Phytophthora capsici	Phytophthora Blight
Beans	*Pythium ultimum*	Pythium Root Rot
	Xanthomonas axonopodis pv. phaseoli	Bacterial Blight

1.4. Five steps to diagnose plant problems

It can be difficult to correctly identify a plant problem and discover a solution. In certain cases, identification may necessitate the assistance of a plant disease expert. However, before going to the experts, try to make a diagnosis of your own. Gather data on possible signs, abiotic pressure, and symptoms at the very least. Despite the fact that outcome is inconclusive, the method is a knowledge opportunity that will offer valuable data. As if you were an investigator trying to solve a murder, pay careful attention to detail when gathering details when diagnosing plant problems. A 10x magnification indicator lens, trowel, pruning shears, digital camera, pocketknife, torch, and somewhat to take records on are all useful things. Create a storage area for documents and reference materials[6].

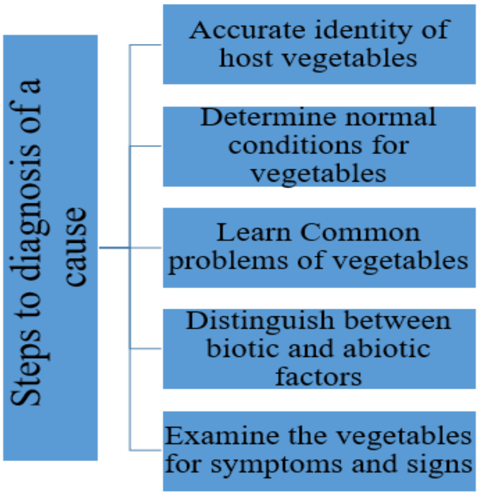

Figure 4: Represents the All Five Steps to Diagnose the Cause in Any Vegetable Disease

From the Figure 4, all the five different types of diagnostic process for any cause associated with vegetable diseases. All the five steps are discussed further-

1.4.1. Accurately identify the host vegetables:

It is known that every variety and species or farmers with a different set forth features which offer a significant signs to extract the basis of problems and for that firstly plant knowledge is necessity.

1.4.2. Determine normal conditions for vegetables:

Find all the plant description and notice other vegetables of the types, diversity or cultivator to decide the usual look of the vegetables.

1.4.3. Learn common problems associated with vegetables:

A suitable reference material may help to match the remark with their explanation or photos of a distinctive vegetable diseases with their sign and symptoms.

1.4.4. Discrimination between abiotic and biotic factors:

Remark carefully to find weather a vegetable infection is produced by a living, biotic factors or by abiotic factors.

1.4.5. Examine the vegetables for sign and symptoms:

Understanding the distinctions between symptoms and signs can aid in infection identification and permit for conversation through others. Indications are the vegetable's reaction to contamination or sign that something is wrong with it.

Entomologists' effective Integrated Pest Management (IPM) programmes for insect and mite control inspired the concept of Integrated Disease Management (IDM). In certain circumstances, IDM involves scouting and the fast application of a range of techniques and tactics. The management scheme involves tracking environmental variables (moisture, nutrients, temperature, soil pH, and so on), disease prediction, and setting financial edges. These procedures implemented in an organised manner, synchronized, and harmonised fashion to maximise the profits of respective variable.

2. LITERATURE REVIEW

Masahiro Shishido[7] demonstrated that modern technology is filled with more influential management implements for crop manufacture and for disease regulator in safe horticulture methods. However the new method of controlling the environment and nutrition of the plants is pushing it towards a new boundaries of development and yield. These set of conditions may place plants beneath stress situation that are difficult to evaluate both in quality and quantity. Secured horticulture organizations should have a well-organized status for usage of biological regulation agents over and above another crop development approach. The chief approach of biological regulation of plant infection is to familiarize rivals to check populations of infection developing microorganisms in the method hence they are incapable to contaminate the crops, or somewhat diminish the capability of performing that. Several hopeful biological regulating agents comprises Trichoderma species, which are tough participants of disease-causing fungus like Botrytis cinerea, and are beneficial to safeguard wound area and stop infectious agents from colonizing at wound area.

Steve Bost[8] elaborated that Fungi (mold), bacteria, viruses and nematodes are responsible for plant diseases. These pathogens do not harm humans but can cause plants serious damage. Gardeners must take adequate proactive and reactive measures to monitor disease. Inappropriately used plant, animal and human beings may suffer from pesticides (insecticides, fungicides, herbicides, etc.). Pesticides should be applied in such a manner that it will not harm people, cattle, crops, profitable insects, fish, and wildlife. It will cause damage to the pollinating agents. Prolonged inhalation of pesticides will cause discomfort for this proper protecting clothes should be wear. Eventually and in accordance with the Law disposal of empty pesticide containers. It is always the legal responsibility of the pesticide applicator to read and follow all label instructions currently available for the specific pesticide used.

Lindy Coate et al.[5] explained that a extensive range of bacteria and fungus infectious agents cause fruit and vegetable diseases after harvest. Some of these infected products will remain quiet before harvest until conditions are more favourable in the development of diseases after harvest. Other infecting pathogens produce surface injuries during and after harvest. It is essential to step down and consider production and post- Harvest Handling Systems in their entirety when developing strategies for controlling post-Harvest Diseases. Many pre-harvest factors have a direct and indirect effect on post-harvest disease development even for post-harvest infections. Post-harvest disease control has traditionally been central to fungicides. Tendencies to decrease chemical use in horticulture are however forcing new strategies to be developed. This presents the 2nd century with an exciting challenge.

Denis Persley et al.[9] defined that in the vegetable industry viral diseases are a major cause of loss. The most often severely affected cultivar includes vegetable cucurbits, capsicum, Tomato Spotted Wilt Virus (TSWV), capsicum and lettuce. Viral disease management requires the inclusion of several methods to prevent or delay crop infection. Once infected, plants cannot be cured. On combining with investigation on disease managing as portion of combined disease supervision project, industry experts have drawn up best practice guidelines. Based on the references technical papers, regional information sessions, material, field day and personal network, statistics on greatest practices is delivered to producers and advisors.

Isaac Kojo Arah et al.[10]explains that the postharvest attribute controlling of tomato originates from the farmland and remains till it achieved by the final customer. The post-harvest attribute grade of fruitlets in portion rely on few pre-harvest performs that is accepted throughout manufacture. The attribute of some fruit later to picked crop can't be enhanced through the usage of any post-harvest cure technique or management performs but then can solitary be retained. Accepting and handling the several parts that pre-harvest causes like fertilisers' use, cropping, ripening stage, farmer choice and irrigation could show in the attribute of fruit at harvest is essential to produce larger attribute fruits at yield. Tomatoes are extremely delicate and exposed to quick quality harm after harvest. The feature and storing lifecycle of tomatoes afterward gathering be influenced solely by the post-harvest aspects but furthermore few pre-harvest aspects throughout generation and till both aspect are accomplished appropriately, excellence harm is a chief challenge for tomato manufacturers and managers till now.

3. DISCUSSION

Vegetarians account for 38 percent of the population in India, which ranks first in the world. Following the arrival of Buddhism and Jainism in the 6th century BC, vegetarianism became more common in the region. Standard regulation methods have changed over the years, and are used in concentrated greenhouse farming on a regular basis. In protected horticulture systems, though, recent techniques has delivered most effective controlling implements for crop development and control of disease. Plants are being pushed to new heights of growth and productivity by precise environmental and nutrient controls that maximise photo-synthates against flowers and fruits. Plants can be subjected to stressful conditions that are difficult to define and measure under this set of circumstances. Few diseases without normal in out of field agricultural circumstances tend to be favoured by these phenomena.

Overall, effective crop production necessitates the management of crop diseases and pests to mitigate the impact of these biotic factors on the plants. As mentioned in this study, handling the ecosystem for disease regulation has resulted in present years in progress thanks to the utilization of environmental control accommodations and a deeper knowledge of the biology of plant's pathogen. However, in the future, these latest technologies must be further incorporated in an advanced herbal farming system that have comprehensive methodology to both disease and pest management to increase disease control effectiveness in protected horticulture.

The effective IPM (Integrated Pests Management) systems established by entomologists for insects and mites regulation inspired the idea of Integrated Disease Management (IDM). In certain situations, IDM entails scouting and the prompt implementation of a variety of techniques and tactics. Site selection and planning, the use of resistant farmers, varying planting practise, altering the land by irrigation, pruning, drainage, thinning, shading, and other approaches, and, if suitable, pesticide use. Observing environmental variables (moisture, soil pH, temperature, nutrients, and so on), disease prediction, and setting financial verges are all essential components of the management scheme. To optimise the benefits of each component, these steps should be implemented in an organised, integrated, and harmonised manner.

4. CONCLUSION

Diseases can strike at any time during the growth of a plant. To protect the plant, it's critical to identify the disease's source quickly and treat it as soon as possible. Infectious diseases carried by living organisms, such as microscopic organisms, can quickly devastate a crop. Postharvest disease losses can arise at any point throughout the post-harvest management process, from yield to intake. It is essential to factor in fruit quantity and quality when estimating postharvest disease losses, since certain diseases cannot make produce unsellable but still reduce product value. Fungi (moulds), bacteria, viruses, and nematodes are all responsible for plant diseases. Although these pathogens are not dangerous to humans, they can cause significant damage to plants. Gardeners must be aware of disease control and take preventive and reactive steps as required. The ability to correctly recognise diseases and other plant problems is important for the implementation of successful control measures. Gardeners are advised to learn about the signs and symptoms of plant diseases. The key objective of vegetable infection control is to decrease the aesthetic and economic harm produced through plant disease. In future, it can be used for organic farming with the help of many advance technologies to monitor the plant health and also the invasion of some disease that can be physically seen. Application of new apps and devices to monitor the suitable plant growth environment and also to check disease causing pathogens.

REFERENCES

1. Benjamin Elisha Sawe, “Countries With The Highest Rates Of Vegetarianism,” world atlas, 2019. .
2. T. I. and G. Philley, “Disease Management,” in Vegetable Resources, TEXAS A&M.
3. O. C. Maloy, “Plant Disease Management,” Plant Heal. Instr., 2005, doi: 10.1094/phi-i-2005-0202-01.
4. H. R. El-Ramady, É. Domokos-Szabolcsy, N. A. Abdalla, H. S. Taha, and M. Fári, “Postharvest Management of Fruits and Vegetables Storage,” 2015.
5. G. J. Lindy Coates, “POSTHARVEST DISEASES OF FRUIT AND VEGETABLE,” brown ogle.
6. L. M. Patricia Hosack, “Preventing and Managing Plant Diseases,” Missouri Master Gardener Core Manual, 2017. .
7. M. Shishido, “Plant disease management in protected horticulture,” Hortic. Res., 2011.
8. Steve Bost, “Home Vegetable Garden Disease Control,” UT Ext., 2014.
9. Denis Persley, “Integrated Viral Disease Management in Vegetable Crops,” 2011.
10. I. K. Arah, H. Amaglo, E. K. Kumah, and H. Ofori, “Preharvest and postharvest factors affecting the quality and shelf life of harvested tomatoes: A mini review,” International Journal of Agronomy. 2015, doi: 10.1155/2015/478041.