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Potato(Solanum) Crop Diseases, Symptoms and their Management: A Survey

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Abstract— Potato (Solanum tuberosum L.) is a major food all over the world with successful large-scale production and consumption. Plant diseases give rise to production and economic losses and also reduction in quality and quantity of agricultural products. However, large number of pests and diseases will be propagated from one crop to another as Potato is a vegetatively reproducible crop. One major cause of low crop yield is the diseases caused by the pathogens like bacteria, fungi,virus and nematodes. In plant Pathology the disease causing organism is called pathogen that may cause significant yield loss in the field . Identifying the diseases in potato plant is not an easy task, it needs experience and knowledge of crop and their diseases. Moreover accuracy is required for describing the symptoms of variety of plant diseases. These diseases cause reduction in the quality, quantity and market value of tubers. Majority of the Potato crops are affected by fungal, bacterial and viral diseases. These affects can be monitored by machine learning techniques and predict the disease in early stage so, that the farmer can avoid the huge crop loss and improve harvest quality. These diseases are reviewed here based on their identification, symptoms on potato plant or tubers, nature of the pathogen involved, epidemiology, management practices, different machine learning classification techniques used and accuracy of disease prediction etc. The main aim of this survey is to understand the various types of potato crop diseases,symptoms of potato crop diseases in the initial stage and also know the use of appropriate management practices to make potato cultivation more efficient, economical and environmentally safe.

Keywords- Potato Life cycle, Role of machine Learning in plant disease detection, Bacterial Disease, Fungal Disease and Viral Disease.

I. INTRODUCTION

THE POTATO IS A STARCHY, TUBEROUS CROP FROM THE PERENNIAL NIGHT SHADE SOLANUM TUBEROSUM, AFTER WHEAT, RICE, AND MAIZE[2] IT IS A MAJOR FOOD CROP.PARTICULARLY IN ASIAN AND EUROPEAN COUNTRIES IT IS REGARDED AS ECONOMICALLY IMPORTANT AND CULTIVATED WORLDWIDE. THE ABILITY TO PROVIDE HIGHLY NUTRITIOUS FOOD PLAYS AN IMPORTANT ROLE IN DEVELOPING COUNTRIES LIKE INDIA. POTATOES ARE AN ANNUAL PLANT, ABOUT 30-100 CM TALL, AND ARE PROPAGATED VEGETATIVELY BY TUBERS[1]. THE TUBERS ARE CARRYING BUDS, COMMONLY REFERRED TO AS "HEADS," WHICH SPROUT ON GERMINATION AND GROW INTO PLANTS. THE TUBERS BEGIN TO DEVELOP WHEN THE PLANT FLOWERS, AND THEIR DEVELOPMENT ENDS WHEN FRUIT FORMATION STARTS. POTATO HAS A WIDE RANGE OF TEMPERATURE ADAPTABILITY (TROPICAL, SUBTROPICAL AND TEMPERATE REGIONS) AND SOIL (LIGHT SANDS TO HEAVY CLAY LOAM) BUT IS PRONE TO DRAINAGE AND AERATION. THE TUBER CONTAINS WATER (80%), CARBOHYDRATES (20%), LOW FAT (0.1%), AMINO ACIDS, MINERALS (2%), AND HIGH POTASSIUM. POTATO HAS LOW LEVELS OF SODIUM, FIBER (0.6 PERCENT), AND VITAMINS (B, C, AND B2) THAT PLAY A CRUCIAL NUTRITIONAL ROLE[3]. POTATO CROPS CAN BE AFFECTED BY APPROXIMATELY 160 DISEASES AND DISORDERS, 50 OF WHICH ARE CAUSED BY FUNGI, 10 BY BACTERIA, 40 BY VIRUSES AND OTHERS BY NON-PARASITIC DISEASES, OR BY REASONS UNKNOWN. POTATO CROPS CAN BE AFFECTED BY APPROXIMATELY 160 DISEASES AND DISORDERS, 50 OF WHICH ARE CAUSED BY FUNGI, 10 BY BACTERIA, 40 BY VIRUSES AND OTHERS BY NON-PARASITIC DISEASES, OR BECAUSE OF UNKNOWN CAUSES. THEY CAN HAVE AN EFFECT ON LEAVES, TUBERS OR BOTH. VIRUS DISEASES ARE DIFFICULT FOR FARMERS TO RECOGNISE BECAUSE SYMPTOMS OF VIRAL DISEASE SUCH AS STRETCHING OF THE LEAF, DISTORTION, STUNTING, VEIN CLEARING, MOSAIC AND MOTTLE CAN BE SIMILAR IN APPEARANCE TO THOSE CAUSED BY ABIOTIC STRESS, HERBICIDE INJURY OR NUTRITIONAL VARIATION[4][5]. DISEASES CAN BE DETECTED USING MOLECULAR TECHNIQUES SUCH AS POLYMERASE CHAIN REACTION INVOLVING THOROUGH SAMPLING AND PROCESSING. EARLY DETECTION OF CROP DISEASES CAN HELP FARMERS MONITOR THE DISEASE BY EFFECTIVE MANAGEMENT STRATEGIES SUCH AS DISEASE-SPECIFIC CHEMICAL FORMULATIONS, APPLICATION OF PESTICIDES, ETC.

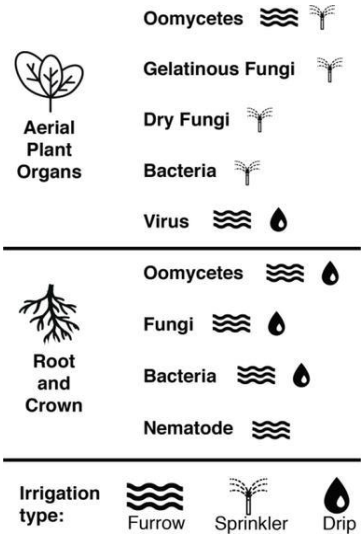


Figure 1. Disease effecting Foiler lesion, Root lesion and type of irrigation

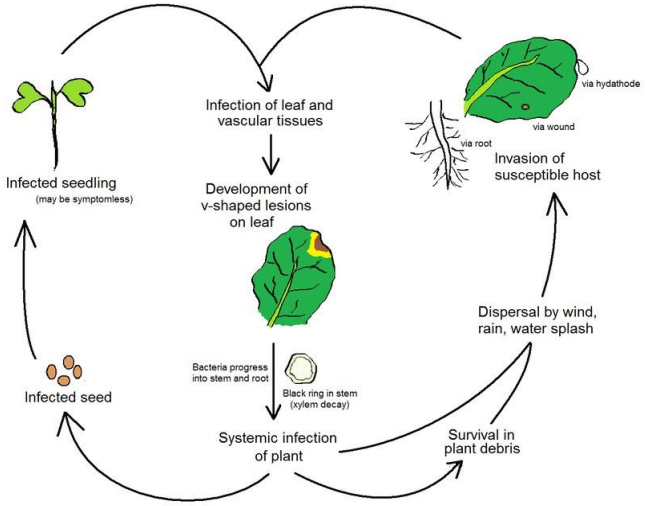


Figure 2. Life cycle of Black rot Pathogen

The most important fungal diseases affect the foliar as well as tuber[6]. The foliar dis-eases involve late and early blights and Phoma blight, whereas the soil and tuber-borne diseases include dry rot, common scab, blackscurf, Verticillum wilt, and Fusarium wild. The lifecycle of one fungal disease is shown, i.e., black rot pathogen (in Fig. 2).Potato plants and tubers are attacked by various bacterial pathogens. Bacterial ring rot, bacterial soft rot, pink eye, common scab, Zebra chip are among the most important bacterial diseases. Bacterial wilt is one of the potato's most damaging diseases, with a very wide range of hosts. The disease is also known as brown rot, southern wilt, eye sore or jammy eye on potatoes. Correct diagnosis is important for successful control of pests and diseases[7]. Without effective control methods, serious diseases such as late blight, ring rot, and leaf roll can cause total crop loss. In the above (see Fig.1) it shows disease affecting various regions of the plant such as root, foiler, and irrigation type. This study includes information on potato crop diseases such as bacterial, fungal, and viral diseases. The information is grouped under the headings symptoms and management practices of potato bacterial disease, symptoms of fungal disease and management practices, and symptoms of and management of viral disease.

II. POTATO LIFE CYCLE

South America is the major place where potato (Solanum tuberosum) is being produced, from the central Andes in Peru. Since 4,000 years, the potato was domesticated and has been grown by indigenous farming communities. In the sixteenth century, it is introduced into Europe. Asia and throughout the world, the crop subsequently was distributed. A major constituent in fulfilling human nutritional requirements is potato. Due to its excellent nutritional content, in many countries potato serves as their major food. There are four general stages which start from the planting and ends at the harvesting in life cycle of the potato. Figure below shows the life cycle of the potato plant.

A. Planting

The first step and the most important stage of life cycle of a potato is the planting. The potatoes that form the eyes are the good potatoes and we obtain large amount of potatoes from such plant because they are grown using the certified seeds that are of high quality and free from any disease. The potatoes does not grow if the soil temperature is less than 45 degrees F.

B. Vegetative Stage

In this stage potatoes grow on their roots and the sprout leaves. If the water level in ground is less, then it results less crop yield.

C. Growth Stage

The potato is highly prefered food all over the world, which generally comes in several shapes including a wide range of colors. In this stage the potatoes are formed on the roots and eventually it happen flower of the plant starts to come and produces more leaves.

D. Harvesting:

In this stage, the harvesting of the potatoes is done which can have different levels of maturity. The early varieties of the potatoes can be harvest at seventy to ninety days.

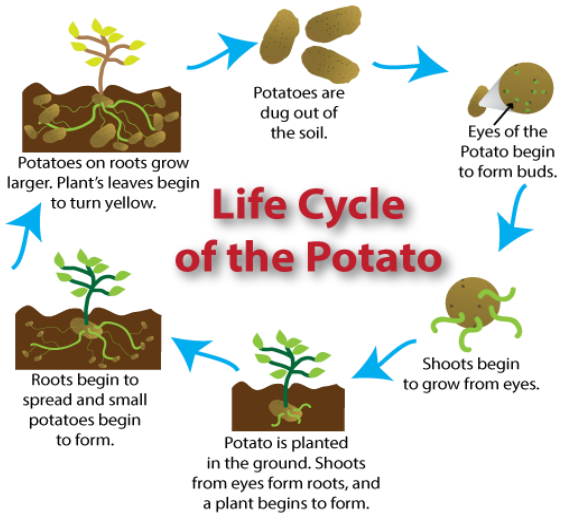


Figure3. Life Cycle of the Potato Plant

III. ROLE OF MACHINE LEARNING IN PLANT DISEASE DETECTION

Machine learning is the one of the branch in Artificial Intelligence to work automatically or give the instructions to a particular system to perform a action[9]. Plants are considered to be the important source of energy supply to mankind. Plant diseases can affect the leaf as well as crop any time between sowing and harvesting which leads to huge loss on the production of crop. A plant disease is a physiological abnormality. Once a plant suffers from any diseases it shows up certain symptoms like outward changes in the physical appearance that are gradually developed and can be witnessed by naked eyes. Elucidation of symptoms are wilt leaf spots, rots and many more.

Current techniques used to identify crop diseases have relied heavily on the use of human vision systems, which aim to investigate physical and phenotypic characteristics such as leaf and stem colour. Production of the disease depends on three disease-sensitive conditions-host plants, a favorable climate and a viable pathogen. All three conditions must be present in order for a disease to occur. This technique is indeed important for the diagnosis of crop diseases, but the use of this technique in the early detection of crop diseases is not successful.

Detection of plant disease plays a crucial role in the agricultural sector. Nevertheless, this requires enormous manpower, more processing time and comprehensive plant disease knowledge. Hence, machine learning is applied to detect diseases in plants as it analyzes the data from different aspects, and classifies it into one of the predefined set of classes. Machine learning will be able to predict the future based on historical or past evidence. Classification is an important concept in machine learning which is used for the classification of plant diseases. Its accuracy depends on the number of samples taken, and depends on the algorithms used for classification. Illustration. 4 shows the different types of classification algorithms for plant disease detection. The purpose of machine learning is to understand the data structure and fit it into models that people can understand and use.

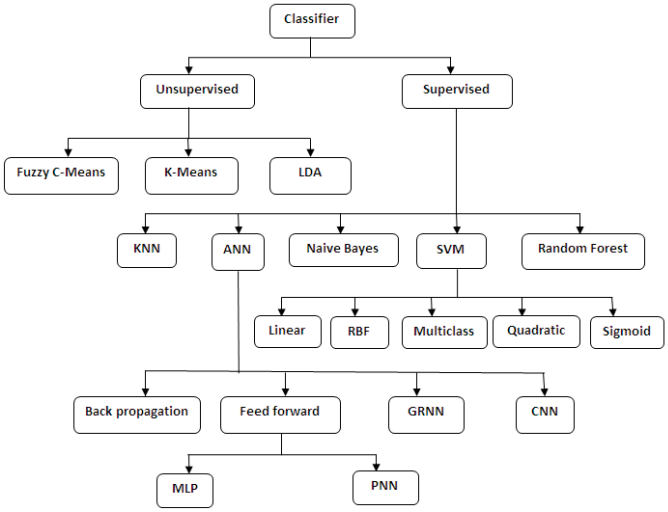


Figure 4. Types of Classification Algorithms

A. Different types of potato diseases and Machine learning techniques

Some of the bacterial, fungal and viral diseases of potato crop along with the Prediction technique using machine learning methods is shown in the table below.

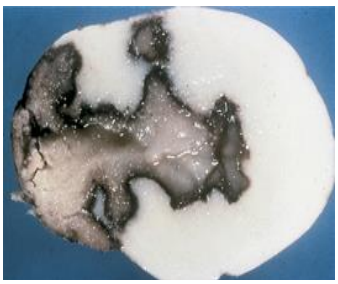
TABLE I. POTATO DISEASES AND MACHINE LEARNING TECHNIQUES

S.No.	Type of Disease	Disease name	Methodology used and Results
1	Bacterial	Black Leg	Convolution Neural Networks (ResNet) [0] Precision of 95 % Recall of 91 %
		Soft Rot	RBF NN algorithm and SVM algorithm [11] SVM algorithm reached up to 89.7%
		Common Scab	Support Vector machines[12] and Random forest Accuracy of 97.1% with the SVM classifier.
2	Fungal	Late Blight	Artificial Neural Networks[13][14] The activation function used is Sigmoid the accuracy is 90.909%
		Black dot	Deep convolutional neural network [15]. If the model is trained with maximum trained data the accuracy is 96%
		Charcoal rot	Genetic algorithm [16] as an optimizer and support vector machines as a classifier. Accuracy of 97%
3	Viral	Tobacco necrosis virus (TNV)	Deep convolutional neural network (DCNN)[17] classification accuracy of 95.73%
		Potato virusY	Support Vector Machines[18] Accuracy of 89.8%

IV. BACTERIAL DISEASE

TABLE II. BACTERIAL DISEASE SYMPTOMS AND MANAGEMENT PRACTICES

Pathogen	Disease	Symptoms	Management	Distribution and author	Image
Pectobacterium spp.	Black Leg	1. Stunting and wilting of affected stems. 2. Leaves on affected stems may be chlorotic,wilted, or brown,	1. Utilize crop rotation of two or more years 2. Avoid excessive fertilization. 3. Surface waters for	World wide Czajkowski, R Et.al.,[19]	

		and plants may get collapse. 3.The decaying and and darkening of stem pith, and vascular tissue in and above the leaf may be discolored	irrigation should be Avoided		
Subsp caroto-vorum pectobacterium subsp. Carotovorum (syn. Erwinia carotovora subsp. caroto-vora), Pectobacterium atrosepticum, and Dickeya dianthicola (syn. Erwinia chrysanthemi)	Stem Aerial Rot	1. It appear as black lesions that are produced on infected stems 2. Dry conditions, stems appear shriveled and dark 3. Occurs higher up the stem and spreading downward,	1.Copper-based treatments to try to reduce the spread of bacteria to healthy plants	World wide Noah Rosenzweig et.al.,[20]	
Pectobacterium carotovorum subsp. carotovorum, Pectobacterium carotovorum subsp. odoriferum, Pectobacterium atrosepticum, Dickeya dianthicola (syn. Erwinia chrysanthemi)	Soft Rot	1.Rotted tis-sues are color-cally creamed to white. 2. When cutting in-fected tubers, the margin of the rotted region turns brown to black, with a strong border between the rotted and sound tissue.	1. Grade out infected tubers. 2. Maintain adequate crop rotations. 3. Do not over water	World wide R.Czajkowski[21] M.C.M. Pérombelon [22]	
Bacterium Clavibacter	Ring Rot	1. Most declared	1. Practise	World wide L. H. Stevens &	

michiganensis subsp. sepedonicus		under dry conditions, and mild to hot (75-90oF). Symptoms above ground include wilting starting with lower leaves, rolling of leaf margins, inter-veinal chloro-sis and necrosis. 2. If wilted stems are cut, a milky exudate can be seen if the lower stem is squeezed. 3.External tuber symptoms may include cracking and darkened blotchy areas of the skin	good hygiene 2.Control groundkeepers	J. G. Lamers[23]	
Ralstonia solanacearum	Brown Rot	1. Being wilt early in disease devel-opment without dead or necrotic leaves and the prominent milky ooze when an in-fected lower stem is put in water. 2.Under favourable conditions the disease	1. Prune out all signs of disease in limbs as soon as they appear 2.Dispose of pruning and other debris to avoid recontaminatio n.	Asia, Africa, South America (probablyworl dwide) Dirk Jan van der Gaag, et.al.,[24]	

		develops, leading to stunting of plants, general wilting and yellowing of foliage and eventual plant death			
Bacterium Dickeya solani	Dickeya Black Leg	1. Pectobacterium atrosepticum is similar to modern blackleg disease. 2.Range from blackleg to top wilt in the growing plant and soft rotting of tubers. 3.The wilt may be rapid as the soft rot moves from the infected tuber through the vascular system of the plant	1. Consult with local extension advisors for proper storage recommendations for your area. 2.After an initial 1-2 week period at 50-60o F, lower the temperature to 38- 42o F for long-term storage.	World wide Yannick Raoul des Essarts[25]	

Streptomyces scabiei, S. acidiscabiei, S. europeiscabiei	Common Scab	1.It infects young developing tubers through the lenticels and through wounds. 2.Damaged tubers have rough, cracked skin with scab like spots 3.Initial infection result in reddish brownspots on the surface of tubers	*1) 1.Adequate moisture and timing of irrigation* 2.Decrease soil pH by adding elemental sulfur. The disease is controlled or greatly suppressed at soil pH levels of 5.2 or lower	World wide SarahBraun, et.al.,[26]	

V. FUNGAL DISEASE

TABLE III. FUNGAL DISEASE SYMPTOMS AND MANAGEMENT PRACTICES

Pathogen	Disease	Symptoms	Management	Distribution	Image
Alternaria alternata	Alternaria brown spot	1.Small, dark-round necrotic lesions varying in diameter from the spot to 1/8-inch. 2.Whole leaves may be affected, they can dry up but often remain attached to the stem. 3.On plant debris an alternata may live. First infection occurs when	1. Rotation to a non-host crop is beneficial, such as a small grain 2.The irrigation should be avoided in cold, rainy conditions. 3.The fungicides are very effective in controlling brown leaf spot.Use contact fungicides with broadspectrum activity	Worldwide Ahmed IS Ahmed [27]	

		spores blown by wind fall on the tissue of the leaves.			
Alternaria solani	Early Blight	1. Older leaves as small brown spots with concentric rings that form a called "bull's eye" pattern. 2.It spreads outward on the leaf causing it to turn yellow, wither and die. Eventually the stem, fruit and upper portion of the plant will become infected. 3.Early blight can occur any time throughout the growing season. High temperatures (80-85˚F.) and wet, humid conditions promote its rapid spread.	1.Prune or stake plants to improve air circulation and reduce fungal problems. 2.Keep the soil under plants clean and free of garden debris. 3.Apply copper-based fungicides early, two weeks before disease normally appears or when weather forecasts predict a long period of wet weather. Alternatively, begin treatment when disease first appears, and repeat every 7-10 days for as long as needed.	Europe, Japan, New Zealand, North America, Russia Isaac K. Abuley[28]	
Phytopthora infestans	Late Blight	1.Water-soaked lesions appear on foliage that,within a few days, becomes necrotic,turning brown when dry or black when wet. 2.Pale yellow	1. Use potato tubers for seed from diseasefree areas to ensure that the pathogen is not carried through seed tuber. 2.Fungicidal sprays on the	World wide Jessica Rupp[29]	

		margin often forms around leaf lesions. 3.Lesions on stems and petioles are black or brown	appearance of initial symptoms. 3.Spraying should be done with Dithane M-45 or Dithane Z-78 (2.5 kg/I 000 litres of water per hectare). Spraying should be repeated at 10-12 days' interval.		
Spongospora subterranea f.sp.subterranea	Powdery Scab	1.Initial symptoms are small, light-colored, blister-like swellings on the tuber surface 2. At an advanced stage, these become dark, open pustules 2 to 10mm in diameter or larger, containing a brown, powdery spore mass	1. A soil fumigation with methane sodium is reported to control powdery scab 2.Resistant potato cultivars exist and should beused. 3.Planting in well-drained soils free of disease and a long crop rotationwith grasses where disease occurs may reduce incidence.	World wide Francisco G.Bittara[30]	
Phytophthora erythroseptica	Pink rot	1. Foliar symptoms of underground infections include wilting and chlorosis. 2. Tubers become	1. Avoid prolonged saturation of soils during irrigation, provide good drainage, and avoid harvesting wet	North America Xuemei (Missi) Zhang[31]	

		infected through diseased stolons . 3. If the tuber is cut the tissue oxidizes to a pinkish tinge, an easy diagnostic characteristic.	tubers. 2.Maintain good airflow, and low temperatures during storage because the fungus is inactive below 40°F. avoid the accumulation of moisture on tubers 3.In areas where pink rot is a problem, treating 2and 4 weeks before harvest.		
Colletotrichumcocodes	Black dot	1.Black dot first appears in mid- to late season as a yellowing and wilting of plants. 2.Affected roots may appear stringy when pulled from the soil. 3. Tubers infected with black dot appear to have a slightly darker or a rash-like appearance that closely resemblessilver scurf.	1. Plant certified seed tubers, maintain adequate levels of nutrients, and avoid overirrigation. 2.When fields become infested, rotate to nonhost crops such as grains for at least 3 years, and control potato volunteers and potato family weeds in the rotation crops	Chile, Europe, Australia, South Africa and Israel Alexander D. Pavlista [32]	
Macrophomina phaseolina	Charcoal rot	1.During hot weather when foliage of affected plants wilts and turns yellow .	1. Before soil temperature exceeds 82°F. harvest as soon as tubers have matured	World wide R. K. Arora and S. M.Paul Khurana [6]	

		2.Affected stems take on a dusty black appearance when small, black fungal structures are formed. This "charcoal dust" symptom, is called ashy stem blight. 3. If tuber infections develop very quickly, many of the tuber tissue may develop a soft rot that turns from white to pink and then black,	2. Plant certified seed tubers. 3. Avoid injuring tubers during harvest. Rotation to nonhost crops for several years is required to reduce occurence of the disease.		
Verticilliumalbo-atrum, Verticillium dahliae	Verticillium wilt	1. Early symptoms are characterized by unilateral leaf yellowing. 2. Below the soil line, damage plants exhibit a darkened vascular system. This disease can greatly reduce yield.	1.Practice crop rotation by alternating potatoes with non-susceptible cereals crops, corn or mustards. 2.In fields where Verticillium wilt has been identified, consider applying Aprovia™ fungicide in-furrow at planting in future years 3. At least twice a week the fields should be monitored..	World wide Robert P. Larkin[33]	

VI. VIRAL DISEASE

TABLE IV. VIRAL DISEASE SYMPTOMS AND MANAGEMENT PRACTICES

Virus	Meansof Transmission	Symptom	Management	Distribution	Images
Tobacco necrosis virus (TNV)	soilfungus *Olpidium brassicae* via zoospores	1.The 'ABC' name refers to (A) dark brown raised patches. (B)dark sunken lesions, sometimes in rings or horseshoe shapes, and (C)light brown cracked patches. 2. Any combination of these symptom can cause dark coalescing rings, dark patches, and mild tan patches.	1.Long rotations would be major precaution for infected fields. 2.Eliminate the alternative host plants will help reduce the risk of disease. 3.Care should be taken to prevent potentially contaminated soil from infecting clean fields.	World wide U.Beuch, et.al., [34]	
Tobacco rattle virus (TRV)	Stubby root nematodes	1. Not usually visible on the tuber surface but in tuber flesh the infection causes brown flecking and arcs. 2. In severe cases these lesions appear corky. Plants grown from infected seed can be healthy but in certain varieties infection may cause stunted stems with mottled and distorted leaves 3. Plants showing these symptoms result in smaller and misshapen tubers with a lower overall yield.	1. Long rotations involving cereals and effective weed control can reduce virus levels in a field, but not the number of nematode vectors. 2. Excessive irrigation should be avoided at tuber initiation as infection is most likely at this stage	Europe, Japan, NewZealand, NorthAmeric a, Russia Shashi K.R. Yellareddyga ri [35]	

Potato mop-top virus (PMTV)	Spongospora subterranea	1.Yellowing of leaves and shortened internodes, resulting in stunted growth, hence the name "mop-top." 2. The primary infection on tubers may be expressed as arcs or rings on the tuber surface. 3. This virus is not passed to all tubers of an infected potato plant.	1. Remove all soil from implements that move from infested fields to noninfested fields. 2. Ensure seed sources are produced in fields free of powdery scab and PMTV through polymerase chain reaction (PCR) testing and bioassay. 3. Plant potato cultivars that do not express tuber necrosis symptoms.	Asia, North America, South AmericaAnd Europe Andy Robinson [36]	
Potato leaf roll virus	Mechanically transmitted PLRV	1. A slight roling and red can occur in the upper leaves. 2. The leaves are dry and brittle and have a papery feel and The bottom leaves may roll. 3. Show a slight yellowing and upturning of the upper leaves.	1. Use certified seed tubers. 2. Complete plant resistance to potato leafroll virus is not available in popular varieties, but many available varieties do not develop tuber net necrosis. 3. Apply insecticides from early to mid-season if aphids and potato leafroll virus are present	World wide Aqleem Abbas[37]	
Potato virus X	Mechanically transmitted PVX	1. Symptoms caused by PVX range from complete latency, mild mosaic to severe mosaic and leaf distortion. 2. Symptoms due to PVX infection occurring during the current season	1. The main control measure is the use of certified seed potatoes. 2. Test and renew the stocks of seed potato 3. Always start spraying in the	World wide A. Kopp, M. Kondrák And Z.Bánfalvi [38]	

		are often absent.	fields with higher quality grades Washing the disinfecting machinery before entering a seed crop.		
Potato virusY	Mechanically transmitted PVY	1.Infected plants are often stunted. 2. Leaf symptoms can range from mild to severe mosaic or mottling. 3. In severe cases leaf drop can occur.	1. Plant seed potatoes with zero level of PVY. WA certified and registered seed potatoes with Rating 1 and Rating 2 have a zero tolerace for PVY. 2.Remove any potato plants showing virus symptoms.	World wide B. A. Coutts and R. A. C. Jones[39]	
Wild potato mosaic virus	PVX,PVM andPVS	1.Yellow, white or green stripes/ spots on foliage 2.Wrinkled, curled leaves 3. Infected fruit appears mottled and develops raised "warty" areas	1.Plant resistant varieties when available or purchase transplants from a reputable source. 2. Avoid working in the garden/farm during damp conditions. 3. Remove and destroy all infected plants. Do *not* compost.	World Wide Cesar E. Fribourg, et.al., [40]	
Cucumber mosaic virus	*Cucumber mosaic virus (CMV)*	1. Appears as a chlorosis and blistering mottle of leaves. 2.Margins of leaves are wavy. Intense yellow flecks may develop over the leaf surface. 3.Plants are stunted.	1. Do not plant potatoes near crops heavily infested with aphids and infected with mosaic virus.	World wide Ankit Kumar Ghorai [41]	

VII. CONCLUSIONS

Potato is the fourth major crop of the world after rice, wheat and maize. It is the fastest growing major crop in the developing world with important economic impact on many poor farming families. If a disease results in the potato crop from the interaction between the plant and a pathogen, its severity is determined by soil abiotic and biotic factors affecting the plant, the pathogen, or both. Potato producers have to aim at limiting contact between plant and pathogens by using for example healthy seeds. Moreover, pathosystems are continuously changing since the pathogens genetically adapt to their hosts or to the environmental conditions implemented by human activities. There are many factors that reduce the yield of the crop among which the diseases like late blight bacterial wilt and potato leaf roll virus which play an important role. Therefore understanding the disease development, epidemiology and life cycle are most important in selecting and implementing its effective management strategy. Management of these diseases is therefore very much essential.

This study aimed at being as exhaustive survey on symptoms, tuber and foilage effected images of potato , distribution and Management practices of bacterial, fungal and viral diseases in potato . Through this survey the one can get clear picture about types of diseases and its associated management practices.Machine learning techniques can prove crucial in coming up with more accurate and practical techniques in disease prediction and identification. In future there is need to use machine learning and artificial intellegence and build forecasting systems for early detection and prediction of crop diseases. By utilizing these aspects the farmer can improve the productivity and quality of crops and it is efficient and timesaving way of disease identification[32] . Further this survey can include diagnosis methods to overcome the above discussed potato diseases and effective machine learning algorithms used to detect the early stage of the diseases in potato crops.

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