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Effect of Bacterial Diseases on the Physiological Functions of the Plant: A Review

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Abstract:

Physiological plant diseases are illnesses that affect plants and are classified as Infectious Plant Diseases and Noninfectious Plant Diseases. They are brought on by disturbance and imbalance in the physiological processes of the plant. The study of the mechanisms underlying the occurrence of these damages becomes connected to the defect incident physiology. In the context of this review, environmental physiology refers to the study of how plants react to their surroundings and change as a result of disease infection.

Keywords: *Physiological plant, infectious factors, infectious factors, noninfectious diseases.*

Introduction

The study of plant functions and the explanation of how these activities are carried out are the focus of the field of plant science known as "plant physiology.". Plant pathology is the study of plant diseases. The two Greek words pathos (suffering, sickness) and logos are the source of the word pathology (discourse, study) (Ainsworth, 1981). The principal causative agent of plant diseases can be roughly categorized as either infectious or noninfectious (Canguilhem, 2012). It includes how plants produce and use food, how the various cells of plants aid their growth and reproduction, and how a plant responds to the outside world (Fosket, 1994). Plants convert elements from the atmosphere and the earth into nourishment. This meal is used to produce the ingredients needed to develop the growing plant's body as well as the energy required for plant growth. Metabolic processes are those (Waraich, 2011). The connection between nutrition and a plant's susceptibility to various diseases appears to be unmistakable because nutrients play a significant role in boosting disease resistance in many types of agricultural crops because they are related to the growth and health of the plant and because a healthy diet gives the plant the essential minerals (Huber, Römheld, & Weinmann, 2012). Because plants create all of the food that people and other animals consume, either directly or indirectly, physiology is a vital science not only for the specialist who studies plants but for everyone else as well. Plants are the only species that can produce their own food, except from some types of bacteria. Through the

process of photosynthesis, plants accomplish this (Mancuso, & Viola, 2015). The molecular interactions that take place during photosynthesis and the internal diffusion of water, elements, and nutrients are the tiniest scales. The ones that regulate plant growth, seasonal shifts, dormancy, and reproduction are the biggest of these (Baldocchi, & Wilson, 2001). Plant diseases appear and are more prevalent at different times of the year based on the environment, the crops planted, and the presence of the pathogen. Figure 1 (Campbell, & Madden, 1990).

Genetic, chemical, and physical variables may have an impact on these modifications. With an emphasis on weather and climate, we want to draw the attention of environmental professionals to the variety of observations, publications from researchers and experts in sectors that address the population's health in relation to environmental elements (Ţiculeanu-Ciurlică, & Mihăilă, 2020). This series of tests is created to determine, whether the neural network genuinely picks up on the "notion" of plant illnesses. Figure 2 demonstrates the various iterations of a single leaf for a collection of leaves chosen at random (Mohanty, Hughes, & Salathe, 2016).

Figure 1. Described the Plant Ailment
Source: Campbell, C.L., & Madden, L.V. (1990)

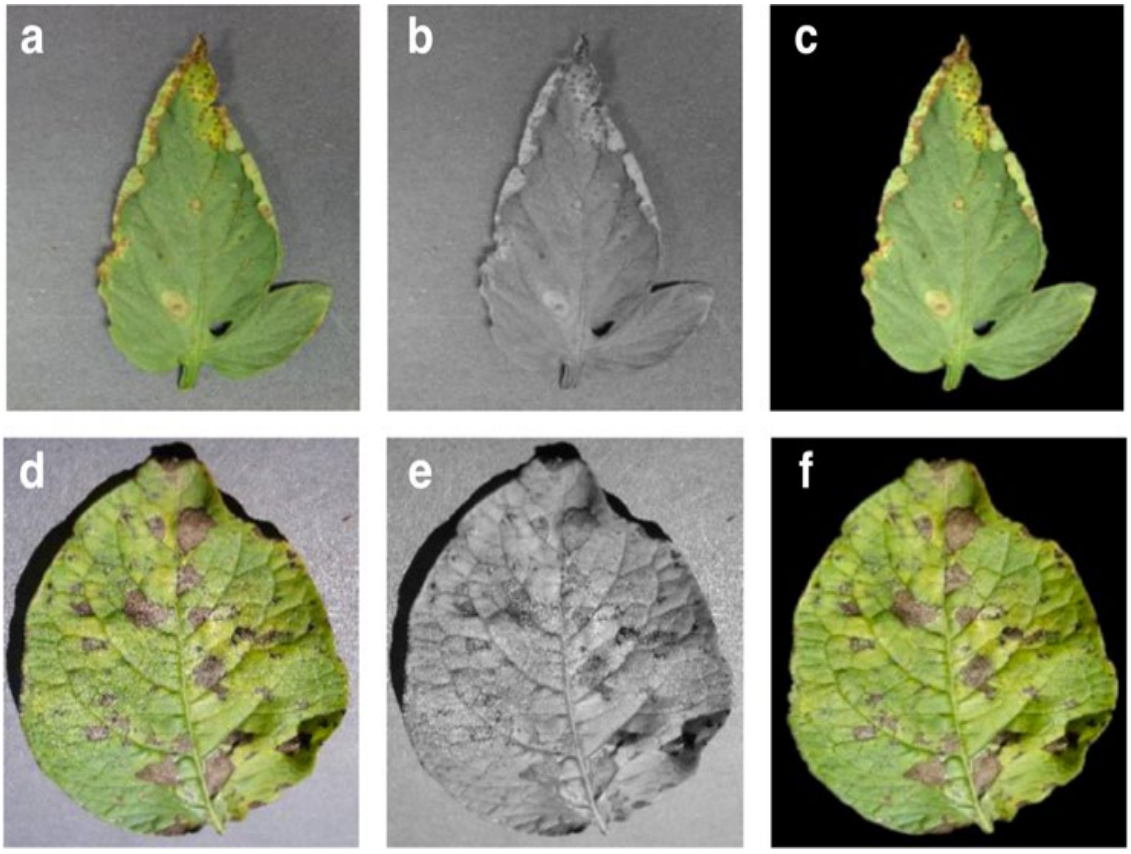

Figure 2. Explained Physiological Plant Diseases
Source: Mohanty, S.P., Hughes, D.P. & Salathe, M. (2016)

Majority of the chemical components of air at the surface of the planet, accounting for 78% of it, followed by oxygen at 21%, with carbon dioxide, water vapor, and many other compounds making up the remaining 1% (Darley, & Middleton, 1966). The production of some (25 crops) is severely hampered by plant diseases, which are the only thing keeping the world's population from being hungry at the rate it is. Disease-related losses in rice, wheat, barley, maize, potatoes, soybeans, and coffee range from 9 to 16 percent worldwide, and fungicides with a market value of more than $5 billion are used in the USA alone to combat disease. The six main agricultural commodities in Australia, which are worth, over (Au$10.9) billion, are predicted to lose (Au$1.3) billion annually as a result of illnesses (Chakraborty, Tiedemann, & Teng, 2000).

There are enormously many causative factors causing the occurrence of physiological plant disease, and therefore possible organized into main groups as follows:

1. Cement factories, smog, particulate matter, fine particles suspended in the air, polluting gases coming from non-photochemical processes, polluting gases arising from photochemical reactions, radiation, and electricity were all included in the first category of air factors.
2. Climatic circumstances and phenomena-related factors These include things like lightning strikes, wind, heat, and lights.
3. Elements affecting the soil in which the plant grows These include conditions including humidity, ventilation, acidity, salinity, alkalinity, a lack or surplus of certain minerals, acidity, and interruptions to irrigation (water fluctuations) (Lucas, 2009).
4. Crop storage conditions-related factors It covers techniques used for storing food, modifications that crop storage undergoes, ammonia damage, oxygen shortage damage, ethylene damage, and cold damage (above zero degrees Celsius). Other than moisture and nutritional inadequacies, infections and insects that create issues had to be avoided. Several physiological problem manifestations were subsequently validated (Figure 3) (Yang, 2022).

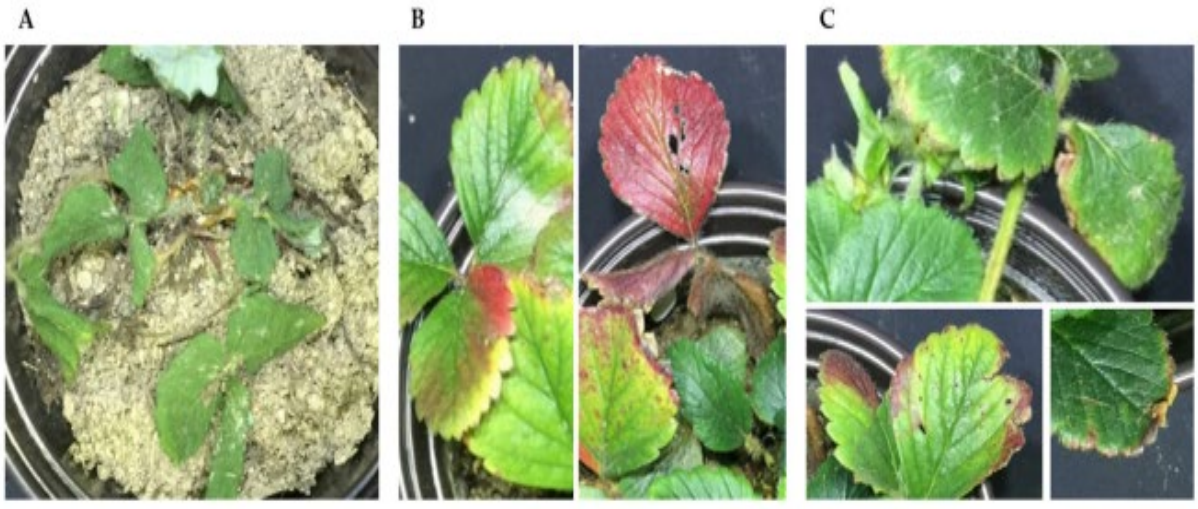

Figure 3. Explained the Symptoms of Physiological Disorders in Experimental Plants: (A) Wilt, (B) Yellowing of Leaves, and (C) Browning of Leaves
Source: Yang, M. (2022)

Some of the most important diseases, caused by plant pathogenic bacteria can be summarized as follows:

- Soft rot illnesses brought on by Eronian and Pseudomonas species: Numerous crops, vegetables, and ornamental plants are wiped out by bacterial soft rot diseases globally. Member in the genera Pectobacterium, Dickeya in the family Pectobacteriaceae in the order Enterobacterales are among the most dangerous causes of these disorders (Van Gijsegem, Toth, & van der Wolf, 2021).
- Numerous bacterial species belonging to various genera are capable of enzymatically macerating parenchymatous tissue from a variety of plants. Soft rot can develop on a developing plant or a harvested crop while it is being stored or transported. It is not known how significant losses are economically; globally, they may range from $50 to $100 x 106 yearly (Perombelon, & Kelman, 1980).
- Bacterial vascular wilt illnesses brought on by Corynibacterium and Pseudomonas species: Emerging topics of study in plant sciences include how endophytic bacteria interact with their host plants and the importance of these inextricably linked microbes for crop protection and production. Endophytic bacteria have important roles in the growth of plants, including promoting growth and biocontrolling diseases and pests. Previous investigations based on cultivation have shown that endophytic bacteria, which are mostly root colonists, are frequently found in smaller numbers (Sekhar, & Thomas, 2015). In the past seven decades, it has been shown that pathogenic bacteria and plant-parasitic nematodes frequently work together to cause plant diseases. The complicated role played by nematodes in these interactions makes each illness complex unique from the others and highly dependent on the particular nematode parasitism at play. Nematodes significantly accelerate bacterially-induced plant disease growth (Siddiqui, et al., 2012).

Xanthomonas and Eronia species-caused bacterial blight illnesses: plant diseases alone account for 500 crores of rupees in annual economic losses. We concentrate on bacterial wilt in this study since it is thought to be one of the deadliest illnesses. Although each type of bacterial infection has its own range of susceptible hosts, a recent study reveals that these host plants frequently overlap. In addition, a number of novel plant wilt-causing species have recently been discovered (Sarkar, & Chaudhuri, 2016). In one orchard in central Poland, many hazelnut cultivars were subjected to leaf spots and cankers in the years 2007 and 2009. Yellow colony was identified inn the edge a sick, seemingly tissue in both years (Pulawska, 2010). Oncological diseases or tuberculosis caused by species of bacteria Agrobacterium, Pseudomonas (Alnor, et al., 1994). Although Agrobacterium species and Ochrobactrum anthropi are typically regarded as harmless in clinical settings, The number of occasional occurrences a human infection due to organism have been recorded during the past ten years. These infections include oncological illnesses or tuberculosis. We looked at 9 cases of septicemia and peritonitis brought on by Agrobacterium-like microbes in 8 patients (Arzai, & Samira, 2011).

Conclusion

In this study, that concluded the environmental conditions affect the physiological functions of the plant and affect the type of bacterial infection of the plant. Thus, the environmental factor plays a fundamental role in the physiological role of the plant and the pathogen.

References

Ainsworth, G.C. (1981). A review of the developments in the field of plant pathology and the influence of plant diseases on history. In *Introduction to the History of Plant Pathology*. Cambridge University Press.

Alnor, D., Frimodt-Møller, N., Espersen, F., & Frederiksen, W. (1994). Infections with the unusual human pathogens Agrobacterium

species and Ochrobactrum anthropi. *Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 18*(6), 914–920. https://doi.org/10.1093/clinids/18.6.914

Arzai, A.H., & Samira, S. (2011). The Anti-Bacterial Potentials of Phage-Therapy: A Review. *Bayero Journal of Pure and Applied Sciences, 4*, 75-78. https://doi.org/10.4314/BAJOPAS.V4I1.17

Baldocchi, D.D., & Wilson, K.B. (2001). Modeling CO2 and water vapor exchange of a temperate broadleaved forest across hourly to decadal time scales. *Ecological Modelling, 142*, 155-184. https://doi.org/10.1016/S0304-3800%2801%2900287-3

Campbell, C.L., & Madden, L.V. (1990). *Introduction to plant disease epidemiology*. John Wiley & Sons.

Canguilhem, G. (2012). *On the Normal and the Pathological*. Vol. 3. Springer Science & Business Media.

Chakraborty, S., Tiedemann, A. V., & Teng, P. S. (2000). Climate change: potential impact on plant diseases. *Environmental pollution (Barking, Essex : 1987), 108*(3), 317–326. https://doi.org/10.1016/s0269-7491(99)00210-9

Darley, E.F., & Middleton, J.T (1966). Problems of air pollution in plant pathology. *Annual Review of Phytopathology, 4*(1), 103-118. https://doi.org/10.1146/annurev.py.04.090166.000535

Fosket, D.E. (1994). *Plant growth and development*. USA: Academic press.

Huber, D., Römheld, V., & Weinmann, M. (2012). Relationship between Nutrition, Plant Diseases and Pests. In book: *Marschner's Mineral Nutrition of Higher Plants* (pp.283-298). https://doi.org/10.1016/B978-0-12-384905-2.00010-8

Lucas, J.A. (2009). *Plant pathology and plant pathogens*. John Wiley & Sons.

Mancuso, S., & Viola, A. (2015). *Brilliant green: the surprising history and science of plant intelligence*. Island Press.

Mohanty, S.P., Hughes, D.P. & Salathe, M. (2016). Using Deep Learning for Image-Based Plant Disease Detection. *Frontiers Plant Sciences, 7*. https://doi.org/10.3389/fpls.2016.01419

Perombelon, M. & Kelman, A. (1980) Ecology of the Soft Rot Erwinia. *Annual Review of Phytopathology, 18,* 361-387. https://doi.org/10.1146/annurev.py.18.090180.002045

Pulawska, J. (2010). Identification and characterization of Xanthomonas arboricola pv. corylina causing bacterial blight of hazelnut: a new disease in Poland. *Journal of Plant Pathology, 2010*, 803-806.

Sarkar, S., & Chaudhuri, S. (2016). Bacterial wilt and its management. *Current Science, 110*(8), 1439–1445. http://dx.doi.org/10.18520/cs/v110/i8/1439-1445

Sekhar, A. & Thomas, P. (2015) Isolation and Identification of Shoot-Tip Associated Endophytic Bacteria from Banana cv. Grand Naine and Testing for Antagonistic Activity against *Fusarium oxysporum f. sp. cubense*. *American Journal of Plant Sciences, 6*, 943-954. https://doi.org/10.4236/AJPS.2015.67101

Siddiqui, Z., Nesha, R., Singh, N., & Alam, S. (2012). Interactions of Plant-Parasitic Nematodes and Plant-Pathogenic Bacteria. In *Bacteria in agrobiology: Plant probiotics*. Springer, Berlin, Heidelberg (pp. 251-267). http://dx.doi.org/10.1007/978-3-642-27515-9_14

Ţiculeanu-Ciurlică, M.-N., & Mihăilă, D. (2020). The conceptual-methodological evolution, from a geographical perspective, of the research of the atmospheric factors that affect the people in a community. *GeoReview, 30*(1).

Van Gijsegem, F., Toth, I.K., & van der Wolf, J.M. (2021). Soft rot Pectobacteriaceae: A brief overview. In *Plant diseases caused by Dickeya and Pectobacterium species* (pp. 1-11). http://dx.doi.org/10.1007/978-3-030-61459-1_1

Waraich, E. A., Ahmad, R., Ashraf, M. Y., Saifullah, & Ahmad, M. (2011). Improving

agricultural water use efficiency by nutrient management in crop plants. *Acta Agriculturae Scandinavica, Section B — Soil & Plant Science, 61*(4), 291–304. https://doi.org/10.1080/09064710.2010.491954

Yang, M. (2022). Physiological Disorder Diagnosis of Plant Leaves Based on Full-Spectrum Hyperspectral Images with Convolutional Neural Network. *Horticulturae. 8*(9), 854. https://doi.org/10.3390/horticulturae8090854