Lesson Plan: Plant Diseases and Climate

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As a **high school** or **undergraduate Biological Sciences** teacher, you can use this set of computer-based tools to teach about **plant diseases, plant pathogens, disease pathology in plants** and the impact of climate on the **incidence and severity of plant disease**.

This lesson plan enables students to learn about plant pathogens and disease. Climate changes such as increasing atmospheric carbon dioxide concentrations and global warming not only affect the growth and cultivation of crops but also the reproduction, spread and severity of plant diseases. This lesson plan teaches about the influence of climate on plant diseases.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in **Biological Sciences**.

Use this lesson plan to help your students find answers to:

- What is plant disease? How does it differ from plant disorders?
- What are the primary causal agents of disease in plants?
- What are plant pathogens?
- What are the signs and symptoms of plant disease?
- How do changing climatic conditions impact the development and spread of disease in plants?

About the Lesson Plan

Grade Level: Undergraduate

Discipline: Biological Sciences

Topic(s) in Discipline: Plant Pathology, Plant Pathogens, Plant Disease, Plant Disease Causal Agents, Plant Host, Plant Parasitic Vector, Pathogenesis, Host-Pathogen-Environment Triangle, Crop Security, Food Security

Climate Topic: Climate and the Biosphere

Location: Global

Access: Online

Language(s): English

Approximate Time Required: 90-120 min

1. **Video micro-lecture (~20 min)**

An introductory video micro-lecture that gives an insight into plant diseases caused by various causal agents: bacteria, nematodes, viruses and fungi. It also briefly describes disease management strategies in field crops.

This can be accessed at:

https://www.youtube.com/watch?v=Kax4n7vaH7M (up to 19.30 min)

2. Reading (~40 min)

A reading that describes the effect of climate change on plant diseases. Climate influences the incidence as well as the temporal and spatial distribution of plant diseases.

This can be accessed at:

https://academicjournals.org/journal/AJB/article-full-text-pdf/8FB297629868

3. Laboratory/Field Activity (~ 30-60 min)

A field activity that teaches about the signs and symptoms of disease in plants.

This can be accessed at:

https://www.apsnet.org/edcenter/disimpactmngmnt/labexercises/ThingsToDo/Pages/Activities.aspx

4. Suggested questions/assignments for learning evaluation

- What is plant disease? How does it differ from plant disorders?
- What are the primary causal agents of disease in plants?
- What are plant pathogens?
- What are the signs and symptoms of plant disease?
- How do changing climatic conditions impact the development and spread of disease in plants?

2 Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1. Topic introduction and discussion

Play the video micro-lecture, 'Introduction to Plant Diseases of Field Crops ', by Dr. Damon Smith from University of Wisconsin, Integrated Crop and Pest Management, to introduce the topic of plant disease. Use the video to describe various causal agents (pathogens) that are responsible for the development of disease in plants. Describe the course of pathogenesis in plants due to pathogens such as viruses, bacteria, nematodes and fungi. Use the video to recognize how plant disease differs from plant disorders. Emphasize on the significance of the host-pathogen-environment triangle for the healthy growth of plants. Finally, discuss how targeted disease management strategies are employed for crop security.

This can be accessed at:

https://www.youtube.com/watch?v=Kax4n7vaH7M (up to 19.30 min)

2. Explain the effect of climate change on plant disease

Use the reading, 'The Effect of Climate Change on Plant Diseases', by Yáñez-López et al (2012), African Journal of Biotechnology, 11(10), 2417-2428, to explain how climate change impacts pathogenesis in plants. Explain that climate can affect the developmental stages of pathogens, the dispersal of pathogens, and the geographical distribution of hosts and pathogens. Thus, discuss how climate change related factors such as global warming and increasing atmospheric carbon dioxide concentrations can affect plant-pathogen interactions. Describe how the changing plant disease distribution and occurrence rates results in greater crop losses and affect food security. Finally discuss how sustainable food production with disease management strategies could be directed for a changing climate.

This can be accessed at:

https://academicjournals.org/journal/AJB/article-full-text-pdf/8FB297629868

3. Extend the understanding

Use this activity, 'Disease Plant Walk', by the American Pathological Society, to teach your students about the signs and symptoms of disease in plants. Distinguish between healthy and diseased plants. Extend the students' understanding of host-pathogen interactions by identifying different diseases in the observed plants and discussing their causal agents. Direct your students to record their observations and to do a follow-up set of observations (after a few days or weeks), in order to note how the disease progressed in these plants. Encourage your students to analyze the recorded observations using parameters such as the host-pathogen-environment triangle and the temporal and spatial distribution of disease. Emphasize on the role of environmental factors on the severity of disease and disease progression. Extend the discussion to include climate change related factors such as global warming and increased atmospheric carbon dioxide concentrations and their possible impacts on plant disease, which in turn can affect crop/food security.

This can be accessed at:

https://www.apsnet.org/edcenter/disimpactmngmnt/labexercises/ThingsToDo/Pages/Activities.aspx

4. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- What is plant disease? How does it differ from plant disorders?
- What are the primary causal agents of disease in plants?
- What are plant pathogens?
- What are the signs and symptoms of plant disease?
- How do changing climatic conditions impact the development and spread of disease in plants?

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- define what are plant diseases and what are the factors influencing it
- classify the various causal agents of disease in plants
- distinguish between signs and symptoms of diseases in plants
- describe the pathology of diseases caused by bacteria, viruses, fungi and nematodes in plants
- understand the balance of the host-pathogen-environment triangle
- discuss how climate change can impact the development of plant disease

4 Additional Resources

If you or your students would like to explore the topic further, these additional resources will be useful.

1. Reading

A report, 'Potato blight model sheds light on climate change and crop diseases', by Climate Change, Agriculture and Food Security (CCAFS-CGIAR) that describes the results of applying the potato blight model worldwide in different agro-systems and emission scenarios, to assess the effect of climate change on crop disease.

This can be accessed at:

https://ccafs.cgiar.org/research/annual-report/2013/potato-blight-model-sheds-light-climate-change-and-crop-diseases#.XNJazY4zaUk

2. Reading

A report, 'Banana disease boosted by climate change', by University of Exeter about an article on the global increased risk of a fungal disease- Black Sigatoka- in bananas due to climate change.

This can be accessed at:

https://phys.org/news/2019-05-banana-disease-boosted-climate.html

5 Credits/Copyrights

1. Video micro-lecture; "Introduction to Plant Diseases of Field Crops"

By Dr. Damon Smith from University of Wisconsin, Integrated Crop and Pest Management.

2. Reading; “The Effect of Climate Change on Plant Diseases”

By R. Yáñez-López, I. Torres-Pacheco, R.G. Guevara-González, M.I. Hernández-Zul, J.A. Quijano-Carranza and E. Rico-Garcia, African Journal of Biotechnology, Vol. 11(10), pp. 2417-2428, 2 February, 2012.

3. Laboratory/Field Activity; “Disease Plant Walk”

By the American Pathological Society.

4. Additional Resources

Report, ‘Potato blight model sheds light on climate change and crop diseases’ by Climate Change, Agriculture and Food Security (CCAFS-CGIAR).

Report, ‘Banana disease boosted by climate change’ provided by University of Exeter, hosted by Phys.org.