Plant Biotechnology and Agrivoltaic Systems: A Sustainable Initiative

Objective: Provide students with a comprehensive understanding of agrivoltaics as a sustainable method for maximizing land use for two key purposes: generating renewable energy and producing bioenergy crops. By examining how photovoltaic systems can be integrated with agricultural practices, students will learn about the various components of agrivoltaics, how shading affects crop growth, and biotechnological methods that improve plant resilience beneath solar panels.

I. Introduction to Agrivoltaics and its Relevance to Bioenergy Production

- ✓ Definition and Relevance
- ✓ Focus on Bioenergy: This approach supports bioenergy initiatives by promoting sustainable methods that boost renewable energy production while improving agricultural efficiency.

II. Agrivoltaic System Components and their Role in Bioenergy Production

- Photovoltaic Panels and Energy Capture: An overview of the photovoltaic (PV) systems utilized in agrivoltaic setups, explaining how solar energy is harnessed for bioenergy applications.
- Crop Growth Under Solar Panels: Discuss how various crops can thrive in the partial shade created by solar panels, including the potential for growing bioenergy crops like certain grasses and legumes.
- ✓ Plant Biotechnology in Agrivoltaics: Explore specific biotechnological methods, such as genetic selection and breeding, that enhance crop resilience and productivity in shaded conditions, benefiting both food and bioenergy crop yields.

III. Impact of Shading on Photosynthesis and Plant Growth

- ✓ Effects of Shading: Educate students on how shading influences photosynthetic rates, plant structure, and overall growth patterns.
- ✓ Adaptive Crop Characteristics: Investigate biotechnological innovations that can help plants adapt to lower light conditions, emphasizing traits such as shade tolerance and effective light use.

IV. Agrivoltaics and Water Use Efficiency

- ✓ Water Dynamics in Shaded Areas: Analyze how the shade from solar panels can decrease evaporation rates and enhance water retention, which affects the water requirements of bioenergy crops.
- Crop Biotechnology for Water Efficiency: Present biotechnological strategies for selecting or engineering crops that exhibit improved water-use efficiency, particularly in agrivoltaic environments.

V. Bioenergy Crop Selection and Management in Agrivoltaic Systems

- ✓ Criteria for Bioenergy Crop Selection: Educate students on the factors to consider when selecting crops for agrivoltaic systems, highlighting species that have potential for biofuel production, such as sorghum and switchgrass.
- ✓ Case Studies in Crop Management: Share case studies showcasing bioenergy crops that have been successfully cultivated under solar panels, focusing on their yield results and bioenergy capabilities.

VI. Assessing Agrivoltaic System Efficiency and Bioenergy Output

- ✓ Biomass and Bioenergy Yield: Introduce methods for measuring and analyzing the biomass yield of bioenergy crops grown under solar panels, including hands-on exercises for collecting yield data.
- ✓ System Optimization: Motivate students to investigate strategies that balance energy capture with crop productivity to enhance land efficiency.
- ✓ Energy Production Metrics: Teach students how to calculate and assess solar panel efficiency in agrivoltaic systems and understand factors that may influence energy output.