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Study of Plant Physiology, Its Aims and Economic Application

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Abstract:
The study of every aspect of a plant's internal functioning—those physical and chemical processes necessary for life as it manifests itself in a plant—falls under the umbrella of plant physiology. This covers research on a range of time and size scales. The interactions of photosynthesis at the molecular level and internal diffusion of water, minerals, and nutrients are the smallest scale interactions. The processes of plant development, seasonality, dormancy, and reproductive control occur at the biggest scale. The main fields of study within the discipline of plant physiology include phytochemistry, phytopathology, and other related topics. In this essay, we'll talk about the objectives and practical uses of plant physiology.
Keywords- *PlantPhysiology, Phytochemistry, dormancy etc.*

I. Introduction:

The study of plant function and behaviour, or plant physiology, includes all the dynamic processes of growth, metabolism, reproduction, defence, and communication that give rise to the existence of plants [1]. In his book Sylva Sylvarum, Francis Bacon published one of the earliest investigations on plant physiology in 1627. Bacon discovered that soil is only necessary to maintain a plant's upright position after growing many terrestrial plants, including a rose, in water. The first quantitative experiment in plant physiology was published by Jan Baptist van Helmont in 1648. He raised a willow tree in a pot with 200 pounds of oven-dried soil for five years. Van Helmont came to the conclusion that plants derive all of their weight from water, not soil, even though the soil only lost two ounces of its dry weight. John Woodward published research on the growth of spearmint in various water sources in 1699. He discovered that soil-infused water outperformed distilled water in terms of plant growth.

Although Julius von Sachs united the various aspects of plant physiology and combined them into a field, Stephen Hales is regarded as the father of plant physiology for the numerous experiments in the 1727 book Vegetable Staticks [2]. His Lehrbuch der Botanik was the standard text on plant physiology at the time. Inorganic ions in water were first identified by scientists in the 1800s as the form in which plants acquire vital mineral elements. Soil serves as a storehouse for mineral nutrients under natural circumstances, but it is not necessary for plant growth in and of itself. Plant roots rapidly absorb nutrients when the mineral nutrients in the soil are dissolved in water, and dirt is no longer necessary for the plant to flourish. This discovery served as the inspiration for the development of hydroponics, a conventional method used in biological research, classroom lab activities, agricultural production, and even as a hobby. Hydroponics involves growing plants in a water solution rather than in soil.

Aims:

The main areas of study within the science of plant physiology can be categorised.

First, the discipline of plant physiology encompasses the study of phytochemistry, or plant chemistry. Plants produce a wide range of chemical substances that are unique to them in order to function and live. A wide variety of pigments, enzymes, and other substances are needed for photosynthesis to take place. Plants must use chemical defence to protect themselves against herbivores, diseases, and rival plants because they are immobile. They accomplish this by creating compounds with a bad taste or smell and poisons. Other substances are used to draw pollinators or animals to distribute mature seeds, while others protect plants from disease, allow survival during droughts, and help plants prepare for dormancy.

Second, the study of the biological and chemical functions of distinct plant cells is a part of plant physiology. There are several characteristics that set plant cells apart from animal cells and that have a significant impact on how plant life operates and reacts differently from animal life. For instance, the cell walls of plant cells restrict their form, which in turn inhibits the flexibility and movement of plants. Chlorophyll, a molecule that interacts with light so that plants can produce their own nourishment rather than relying on outside sources like mammals do, is also found in plant cells.

Thirdly, interactions between cells, tissues, and organs within a plant are the focus of plant physiology. Different tissues and cells are chemically and physically specialised to carry out various tasks. Rhizoids and roots serve to anchor the plant and take up minerals from the soil. To produce nutrients, leaves capture light. Minerals that the roots obtain must be transferred to the leaves, and nutrients produced in the leaves must be transported to the roots for both of these organs to remain alive. Plant physiologists research the operation of the many routes of transport that plants have created, such as vascular tissue, to accomplish this transfer.

Fourthly, plant physiologists research how plants regulate or control their internal processes. In a similar manner to animals, plants also create hormone-like substances that tell cells in other parts of the plant to react. Due to photoperiodism, a process where light-sensitive chemicals react to the length of the night, many flowering plants blossom at the proper time. The generation of the gas ethylene by the plant affects the ripening of fruit and leaf loss in the winter.

Environmental physiology:

On the one hand, environmental physiology is a relatively new area of study in plant ecology, and on the other, it is one of the oldest. Plant physiologists prefer the term "environmental physiology," but it is known by a variety of other names in the applied sciences. It is roughly equivalent to agronomy, horticulture, crop ecology, and ecophysiology. The precise term given to the subdiscipline reflects its point of view and research objectives. Whatever name is used, it concerns with how plants interact with their surroundings and hence intersects with ecology.

Environmental physiologists study how plants react to various physical conditions, including wind, fire, and radiation (including light and ultraviolet radiation) [3]. Water interactions, which can be detected with a pressure bomb, stress from drought or flooding, gas exchange with the atmosphere, and the cycling of nutrients like nitrogen and carbon are all very significant.

Plant responses to biological influences are also studied by environmental physiologists. This encompasses both good relationships like mutualism and pollination as well as both negative interactions like competition, herbivory, illness, and parasitism.

a) **Tropisms and Nastic movements**

Both directed and non-directional stimuli can elicit a response from plants. Tropism refers to a response to a directed stimuli, such as gravity or sunlight. A nastic movement is a reaction to a nondirectional stimuli, such as temperature or humidity.

Plant trophisms are caused by differential cell growth, in which cells on one side of the plant lengthen more than those on the other, leading the portion to bend toward the side with less development. Phototropism, or the bending of a plant toward a light source, is one of the frequently seen tropisms in plants. When a plant needs more light for photosynthesis, phototropism enables it to either maximise light exposure or reduce it in environments with high light and heat. A plant's roots may sense the direction of gravity and grow downward according to geotropism. Tropisms typically come up as a result of how the environment affects how one or more plant hormones are produced.

Nastic motions are caused by differences in cell growth (such as epinasty and hiponasty) or by quickly changing turgor pressure in plant tissues (such as nyctinasty). A well-known illustration is the thigmonasty (reaction to touch) in the carnivorous Venus fly trap. The traps are made of altered leaf blades that include delicate trigger hairs. The leaf folds inward when an insect or other animal touches the hairs. This system enables the plant to capture and ingest tiny insects for extra nutrients. Changes in internal cell pressures cause the trap to close quickly, but the leaf must develop slowly to reset for a subsequent chance to capture insects.

(a) Plant disease

The study of plant illnesses and how plants fight against infection is known as phytopathology, and it is one of the most economically significant fields of study in environmental physiology. The same disease-causing pathogens that affect animals, such as viruses, bacteria, and fungi, as well as physical invasion by insects and roundworms, also affect plants.

Plants' biology is distinct from that of mammals, hence their symptoms and reactions are very different. To stop the spread of illness, a plant may occasionally just lose infected leaves or blossoms, a process known as abscission. This method for disease management is not available to the majority of animals. Because plants typically cannot transmit illness through casual physical touch, plant diseases organisms themselves are different from those causing disease in animals. Animal vectors or spores are typically used to propagate plant infections.

The discovery of Bordeaux mixture in the nineteenth century was one of the most significant developments in the management of plant disease. The combination of copper sulphate and lime is the first known fungicide. The mixture's application helped to prevent the spread of downy mildew, which posed a significant danger to the French wine industry [4].

Economic applications:

Food production

Plant physiology is a key area of study in horticulture, agriculture, and food science as it relates to fruits, vegetables, and other consumable plant components. Climate needs, fruit drop, nutrition, ripening, and fruit set are some of the subjects covered. The study of plant physiology, which addresses issues like ideal planting and harvesting periods, post-harvest storage of plant products for human consumption, and the creation of secondary goods like pharmaceuticals and cosmetics, is essential for the production of food crops.

II. Result and Conclusions:

In contrast to studying each plant individually, crop physiology takes a step back and examines a field of plants as a whole. Crop physiology examines how plants interact with one another and how to improve outcomes, such as food production, by figuring out things like the ideal planting density.

Environmental physiology, a subfield of plant physiology, studies how plants react to their surroundings and how those responses vary. A plant's ability to operate may change as a result of stress from water loss, alterations in the chemistry of the air, or plant crowding. Genetic, chemical, and physical variables all have an impact on these modifications.

Environmental physiologists study how plants react to environmental elements like wind, heat, fire, and radiation. Water relationships, the stress of drought or flooding, gas interaction with the atmosphere, and the cycling of nutrients like nitrogen and carbon are all crucial. They also look at how plants react to biological influences. This encompasses both good relationships like mutualism and pollination as well as both negative interactions like competition, herbivory, illness, and parasitism.

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