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Review On Biotic Stress On Plant

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Abstract

The Plants are subjected to a variety of environmental stresses, which reduces and limits agricultural crop productivity. Environmental stresses that affect plants are of two types: biotic and abiotic stresses. Abiotic stress includes temperature, ultraviolet radiation, salinity, floods, drought, heavy metals, etc., which results in the loss of important crop plants globally, while biotic stress refers to damage caused by insects, herbivores, nematodes, fungi, bacteria, or weeds. Plants respond to all these environmental factors because the pants are fixed in a particular place. To cope with these stresses, a number of strategies have been developed by plants. They detect that the environmental stresses become activated and then generate the necessary cellular responses. Several investigations have been carried out to determine and understand plant assimilates partitioning and stress-tolerance plant genotype necessary for the understanding of the complexity of the response of a plant to biotic and abiotic stresses.

Introduction

The Plants are continuously exposed to a diverse range of biotic stressors throughout their life cycle. Unlike animals, plants cannot escape these threats, making their survival dependent on highly sophisticated defense systems. Biotic stress accounts for significant economic losses in agriculture and poses a challenge to global food security. Understanding plant–pathogen interactions is therefore essential for developing resilient crop varieties.

Abiotic stresses and Biotic stress on crop plants

Plants are subjected to a variety of abiotic stresses, all of which have an impact on crop yield around the world. The major biotic and abiotic stresses in plants are described in Figure 1. These include drought, salt, cold, heat, and toxins.

Crop plants and biotic stresses

Plants are subjected to a variety of biotic stress caused by various living organisms such as fungi, viruses, bacteria, nematodes, and insects. These biotic stress agents induce a variety of diseases, infections, and damage to crop plants, lowering agricultural yields. However, different strategies for overcoming biotic stressors have been created through research methodologies. The biotic stresses in plants can be overcome by studying the genetic mechanism of the agents causing these stresses . Genetically modified plants have proven to be a great effort against biotic stresses in plants by developing resistant varieties of crop plants.

Plant-parasitic nematodes feed on the contents of plant cells and can feed on all sections of the plant, but they predominantly cause soil-borne illnesses and affect the root system. They cause wilting and stunting, which are signs of nutritional inadequacy. Viruses cause not only local but also systemic damage to plants, causing stunting, chlorosis, and deformities in many areas of the plant, despite the fact that they rarely kill their hosts . Plants are harmed when insects feed or lay eggs on them. Viruses can be transmitted to plants by piercing-sucking insects via their stylets. There are two types of fungus parasites: nectrotrophs, which use toxins to kill host cells, and biotrophs, which do not. They induce vascular wilts, leaf spots, and cankers, among other symptoms, and can infect different sections of the plant when combined with bacteria .

Types of Biotic Stress

1 . **Pathogens** ; Pathogens include fungi, bacteria, viruses, phytoplasmas, and oomycetes, each with unique infection strategies.

2 . **Fungi** ; (e.g., Fusarium, Alternaria) cause cell death, wilting, and rotting.

3 .**Bacteria** ; (e.g., Xanthomonas, Pseudomonas) often enter through wounds or stomata and produce toxins or enzymes.

4 . **Viruses** ; (e.g., TMV, CMV) hijack host cellular machinery, leading to mosaic symptoms, stunting, and reduced yield.

5 . **Oomycetes** ; (e.g., Phytophthora) cause devastating diseases like blight and downy mildew.

Insects and Herbivores

Insects cause direct tissue damage and may act as vectors for pathogens. Examples include aphids, whiteflies, caterpillars, and beetles. Their feeding triggers complex defensive signaling pathways in plants.

Nematodes ; Plant-parasitic nematodes such as Meloidogyne spp. induce root galls and interfere with nutrient uptake.

Weeds ; Weeds compete for resources and may harbor pathogens and insects that further stress crop plants.

Impact on plants

1 . Physiological disruption: Biotic stress can negatively affect key plant functions like photosynthesis, transpiration, and respiration.

2 . Reduced yield and quality: The damage from biotic stress can lead to substantial yield losses and a decrease in the quality of fruits, grains, and vegetables.

3 . Increased vulnerability: Plants weakened by biotic stress may become more susceptible to other stressors, like drought or heat.

Future Perspectives ;

Advancements in genomics, transcriptomics, and metabolomics are transforming our understanding of plant defense mechanisms. Climate change may increase pathogen pressure, making the development of multi-stress-resistant varieties crucial. Biotechnological innovations hold promise for building resilient agricultural systems.

Conclusion

Biotic stress poses a significant challenge to global crop productivity. However, plants possess remarkable defensive strategies that can be enhanced through breeding, biotechnology, and sustainable management practices. A deeper understanding of plant–pathogen interactions will be essential for securing food production in the future.

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