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Phytoplasmas Morphology and its Symptoms

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Perspective

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INTRODUCTION

Phytoplasmas are earlier stages intracellular parasites of plant phloem tissue and the insect vectors that carry them from plant to plant.

Phytoplasmas are pathogens that cause a variety of symptoms in agriculturally important plants including coconut, sugarcane, and sandalwood, ranging from mild yellowing to death. Phytoplasmas are most common in tropical and subtropical environments. They are spread from plant to plant by vectors (usually sap-sucking insects like leafhoppers), in which they survive and reproduce.

Phytoplasmas are molecules with a triple-layered membrane instead of a cell wall. Most phytoplasma cell membranes studied so far have a single immunodominant protein of unknown function that accounts for the majority of the protein in the membrane. A typical phytoplasma is pleiomorphic or filamentous in shape and has a diameter of less than 1 m. Phytoplasmic DNA, like that of other prokaryotes, is distributed throughout the cytoplasm rather than being concentrated in a nucleus.

Phytoplasmas can infect and cause symptoms in over 700 different plant species. One distinguishing feature is abnormal floral organ development, which includes philology (the production of leaf-like structures in place of flowers) and virescence (i.e., the development of green flowers attributable to a loss of pigment by petal cells). Flowering plants that harbour phytoplasma may be sterile. The expression of genes involved in the maintenance of the apical meristem or the development of floral organs is altered in phytoplasma-infected plants' morphologically affected floral organs.

A phytoplasma infection frequently causes leaf yellowing, which is most likely caused by the presence of phytoplasma cells in phloem, which can affect phloem function and carbohydrate transport, inhibit chlorophyll biosynthesis, and cause chlorophyll breakdown. These symptoms could be due to infection-induced stress rather than a specific pathogenetic process.

Because of changes in their normal growth patterns, many phytoplasma-infected plants develop a bushy or "witches broom" appearance. Most plants have apical dominance, but infection can cause axillary (side) shoot proliferation and internode size reduction. Such symptoms can be beneficial in the commercial production of poinsettias. Infection causes more axillary shoot production, causing poinsettia plants to produce more than one flower.

Insects from the families Cicadellidae (leafhoppers), Fulgoridae (plant hoppers), and Psyllidae (jumping plant lice) spread phytoplasmas primarily by feeding on the phloem of infected plants, ingesting phytoplasmas and transmitting them to the next plant on which they feed. As a result, the host range of phytoplasmas is highly dependent on the insect vector.

Phytoplasmas have a major antigenic protein that makes up the majority of the cell surface protein. This protein binds to insect microfilament complexes and is thought to regulate insect-phytoplasma interactions. Overwintering phytoplasmas can occur in insect vectors or perennial plants. Phytoplasmas can have a variety of effects on their insect hosts, including decreased and increased fitness.

DESCRIPTION

Phytoplasmas enter the insect body *via* the style, pass through the intestine, and then move to the hemolymph (38) and colonies the salivary glands, a process that can take up to three weeks. Phytoplasmas can be found in almost every major organ of an insect host once they have become established. The latency period is the time between insect ingestion and attainment of an infectious titer in the salivary glands.

Phytoplasmas can also be transmitted through dodders (Cuscuta) or through vegetative propagation, such as grafting infected plant tissue onto a healthy plant.

Because phytoplasma-caused diseases could not be cultured prior to the molecular era, diagnosis was difficult. As a result, traditional diagnostic techniques such as symptom observation were employed. Plants with suspected phytoplasma infections were also studied using ultrathin sections of phloem tissue. Additionally, antibiotics such as tetracycline were used empirically.

Molecular diagnostic methods for phytoplasma detection emerged in the 1980’s, including Enzyme-Linked Immuno Sorbent Assay (ELISA)-based methods. Polymerase Chain Reaction (PCR)-based techniques were developed in the early 1990’s; these are far more sensitive than ELISAs, and Restriction Fragment Length Polymorphism (RFLP) analysis allowed accurate identification of various phytoplasma strains and species.

Phytoplasmas are normally controlled through the breeding and planting of disease-resistant crop varieties (possibly the most cost-effective option) and the control of insect vectors.

Tissue culture can be used to create healthy phytoplasma-infected plant clones. Prior to tissue culture, cryotherapy (freezing plant samples in liquid nitrogen) increases the likelihood of producing healthy plants. Plant bodies that target phytoplasmas have also been created.

Phytoplasmas are bacteriostatic to tetracyclines. However, in the absence of continuous antibiotic administration, disease symptoms reappear. Tetracycline is thus ineffective as an agricultural control agent, but it is used to protect ornamental coconut trees.

CONCLUSION

Acholeplasmatales is the monotypic order of Phytoplasmas. In 1992, the Subcommittee on Molecule Taxonomy proposed using the term 'phytoplasma' rather than 'mycoplasma-like organisms’ to refer to phytopathogenic molecules. The generic name Phytoplasma was adopted in 2004 and is currently Candidates (Ca.) status (used for bacteria that cannot be cultured). Taxonomy of Phytoplasma is complicated because the organisms cannot be cultured; thus, methods used to classify prokaryotes are unavailable. Differences in fragment sizes produced by restriction digests of 16S ribosomal RNA gene sequences (RFLPs) or comparisons of DNA sequences from 16s/23s spacer regions are used to classify phytoplasma taxonomic groups.