Abstracts of Special Session Presentations

Biology of Plant Pathogens

Aquatic Plant Pathology

Fungal pathogens: Their role in the ecology of floating and submerged freshwater plants. R. CHARUDATTAN. Plant Pathology Dept., University of Florida, Gainesville, FL. Phytopathology 95:S120. Publication no. P-2005-0001-SSA.

Freshwater plants encompass a diverse group of morphologically and taxonomically dissimilar plants adapted to life in a highly unstable habitat. These plants can be emergent and free-floating, emergent and rooted, fully submerged and free-floating, or fully submerged and rooted. A variety of fungi in the Oomycota, Chytridiomycota, Anamorphic fungi, Ascomycota, and Basidiomycota cause diseases on these plants. While pathogenic fungi can regulate plant population density by limiting plant growth and seedling recruitment, opportunistic parasites accelerate senescence of older growth and recycle nutrients from dead tissues. In general, the epidemiological models derived from terrestrial plant diseases can be applied to describe diseases on aerial parts of emergent plants; the disease dynamics of submerged plants are less clearly understood. Experience from highly invasive freshwater plants such as *Eichhornia crassipes*, *Hydrilla verticillata*, and *Myriophyllum spicatum* indicates that large-scale epidemics are rare and episodes of small-scale epidemics often go unnoticed due to their limited impacts. Several fungal pathogens have been studied as biological control agents to manage highly invasive and economically destructive aquatic weeds, but success is often limited by these plants' capacity for rapid disease compensation through vigorous vegetative growth. This trait, coupled with a disease-escape strategy based on vegetative fragmentation, enables these plants to avoid wholesale destruction from pathogens and to succeed as primary colonizers of unstable aquatic habitats.

Evaluation of bacterium SG-3 as a potential microbial algicide. H. L. WALKER (1), L. R. Higginbotham (1), and M. Ding (1,2). (1) Louisiana Tech University, Ruston, LA; (2) Current Address: Dept. of Microbiology and Immunology, Louisiana State University, Shreveport, LA. Phytopathology 95:S120. Publication no. P-2005-0002-SSA.

Cyanobacteria are often associated with harmful algal blooms. *Oscillatoria perornata* produces 2-methylisoborneol (MIB) and several *Anabaena* species produce geosmin. Off-flavor caused by MIB and geosmin results in substantial economic losses in the commercial production of channel catfish (*Ictalurus punctatus*). As a result of research to manage off-flavor, bacterium SG-3 was isolated from a commercial catfish pond in Louisiana. In laboratory studies, SG-3 lysed the cells of several cyanobacteria, including species of *Oscillatoria* and *Anabaena*. The potential for using SG-3 to control selected cyanobacteria was studied using 757-L polypropylene tanks. Each tank was filled with 568-L of pond water and stocked with 10 channel catfish fingerlings. In these studies, *O. perornata* was reduced from an initial density of 3,900 trichomes per milliliter to 0 trichomes per milliliter within 2 days after application of SG-3 inoculum. Similar results were observed for other experiments. The fish exhibited no adverse effects that were attributed to SG-3. *Microcystis* spp., *Plectonema* spp., and members of the Chlorophyceae appeared to be resistant to SG-3. Bacterium SG-3 was deposited in the Agricultural Research Service Patent Culture Collection, Peoria, Illinois and assigned the number NRRL B-30043.

Development of an indigenous pathogen for management of the submersed freshwater macrophyte *Hydrilla verticillata*. J. F. SHEARER. U.S. Army Corps of Engineers, Research and Development Center, Vicksburg, MS. Phytopathology 95:S120. Publication no. P-2005-0003-SSA.

Hydrilla verticillata (L.f.) Royle (hydrilla) is considered one of the three most important aquatic weeds in the world. Plant infestations can impede navigation, clog drainage or irrigation canals, affect water intake systems, interfere with recreational activities, and disrupt wildlife habitats. The plant is an excellent competitor in aquatic habitats because it can photosynthesize at low light levels, has wide environmental tolerances, and produces several types of extended survival propagules. The indigenous fungal pathogen, *Mycoleptodiscus terrestris* (Gerd.) Ostazeski, (Mt) has shown significant potential for use as a bioherbicide for management of hydrilla. Liquid fermentation methods have been developed and patented that yield stable, effective bioherbicidal propagules of Mt. Under appropriate nutritional conditions, aerated Mt cultures produce high concentrations of vegetative biomass that differentiates to form compact hyphal aggregates or microsclerotia (ms). The microsclerotia germinate both vegetatively and sporogenically thus improving their potential to infect and kill hydrilla. Applied as a liquid inoculum to hydrilla the microsclerotial matrix was capable of significantly reducing hydrilla shoot biomass as high as 99%. Air-dried microsclerotia were capable of hyphal germination in 24 hours and sporogenic germination in 72 hours. Hyphal germination of the microsclerotia that impinge on hydrilla plant surfaces can provide initial infection sites followed several days later by secondary infection resulting from the development and release of spores from the surface of the microsclerotia. Dry inoculum applied at 40 mg/L has been shown to reduce hydrilla shoot biomass greater than 93% and up to 100% by 4 weeks post inoculation compared to untreated control plants.

Marine host-pathogen interactions. G. SMITH. Biology Dept., University of South Carolina, Aiken, SC. Phytopathology 95:S120. Publication no. P-2005-0004-SSA.

Attention has only recently been paid to diseases of coral reef organisms. Although a few, or all, of these diseases may have existed for some time, increased prevalence has made them difficult to ignore. Pathogens have been identified with a number of coral diseases and include ciliates, bacteria and fungi. Geographic and host ranges vary considerably. One disease, aspergillosis of gorgonian corals, was identified approximately ten years ago and it is among the best understood of the coral diseases. The causative organism is *Aspergillus sydowii*. All Caribbean gorgonians appear susceptible to this disease. Host defensive mechanisms have been described which include galling and the production of anti-fungal compounds. In this respect, gorgonian responses resemble some plant responses. The disease has resulted in the elimination of sea fans in some areas and in species dominance shifts in others.

Identification of microbes associated with coralline lethal algal disease and its relationship to glacial ice melt (global warming). J. M. CERVINO (1), M. Littler (2), D. Littler (2), S. Polson (2), T. J. Goreau (3), B. Brooks (2,4), and G. W. Smith (5). (1) Pace University, New York, NY; (2) Smithsonian, Washington, DC; (3) Medical University of South Carolina, Charleston, SC; (4) Global Coral Reef Alliance, Cambridge, MA; (5) University of South Carolina, Aiken, SC. Phytopathology 95:S120. Publication no. P-2005-0005-SSA.

A cluster of five bacterial species consistently associated with Corraline Lethal Orange Disease (CLOD) have been identified. Crostose Red Alga *Porolithon*

spp. have been affected by this disease, and exhibited high mortality, according to studies performed from 1996 through 2001. The decayed crostose algae were surrounded by a rapidly expanding orange-yellow pigmented biofilm attacking the *Porolithon* crusts with expanding circles of orange rimmed (about 1.0 cm wide) dead skeleton. The 16S rRNA genes from these bacteria were sequenced and found to correspond with five different species of glacial ice bacterium genetically related to the genus *Planococcaceae* with a degree of relatedness of 98-99% to type strains *Planococcus citreus*, *Planococcus* sp. (SOS Orange) and *P. mcmeekinii*, these bacteria all fall within a group of Antarctic ice bacterium. Also found was, *Bacillii* with a degree of relatedness of 99% to type strain *Bacillus pumilus*, and *Pseudomonas* with a close similarity of 99% to type strain *Pseudomonas oleovorans*. These three different bacteria were found to be culturable from all diseased specimens and *in vitro* introduction of these isolates onto healthy algae initiated lesions identical to CLOD. Temperature experiments indicate that higher temperatures are a critical factor in infection and the rate of spread. When temperatures are lowered below 23°C during aquaria experiments the orange lesion degrades. Warmer temperatures may be linked to the virulence and rate of spread of these pathogens. Glacial ice-cap melting due to global warming may be circulating increased concentrations of cold adapted bacteria to lower latitudes in the tropics causing diseases that are affecting encrusting substrates that provide foundational habitat for corals and other marine organisms.

History of Plant Virology: A Century of Developing a Discipline

After the double helix: Rosalind Franklin's research on *Tobacco mosaic virus*. A. N. H. CREAGER (1) and G. J. Morgan (2). (1) Princeton University, Princeton, NJ; (2) Spring Hill College, Mobile, AL. Phytopathology 95:S121. Publication no. P-2005-0006-SSA.

In many ways the molecular biology of the 1950s could be described as the decade of the helix: the alpha helix of proteins, the double helix of DNA, and the helical nature of *Tobacco mosaic virus* (TMV) were all major discoveries. Our paper examines the interplay between structural studies of DNA and of viruses by focusing on the work of Rosalind Franklin. Franklin is best known for her x-ray diffraction patterns of DNA, which provided crucial parameters for the Watson-Crick double-helical model. However, her scientific career did not end when she left King's College. At Birkbeck College in the laboratory of J. D. Bernal, she employed the same techniques to produce the finest diffraction patterns to date for TMV. With Donald Caspar, she determined that the RNA in TMV was not situated in the center of the rod-shaped virus, as previously thought, but at a 40 Angstroms radius. Franklin also corrected James Watson's earlier characterization of TMV's helical nature, showing that TMV had 49 subunits per 3 turns of the helix. Franklin's contributions to the structural determination of TMV continued until her untimely death in 1958, in collaboration with Aaron Klug, Kenneth C. Holmes, and biochemists in Tübingen and Berkeley. Franklin also corresponded with both Watson and Crick, who were engaged in work on virus structure during the same period. Developments in TMV research during the 1950s illustrate the connections between structural studies of nucleic acids and structural studies of proteins and larger macromolecules (such as plant viruses). They also reveal how the protagonists of the "race for the double helix" continued to interact scientifically and personally during the years that Watson and Crick's model for the double-helical structure of DNA was debated and confirmed.

Virus design: From Crick and Watson to Caspar and Klug. G. J. MORGAN. Spring Hill College, Mobile, AL. Phytopathology 95:S121. Publication no. P-2005-0007-SSA.

The early history of structural virology exhibits concrete connections between art and science. In this paper, I explore the connections between the scientific work of Francis Crick, James Watson, Rosalind Franklin, Aaron Klug, and Donald Caspar and the pop artist John McHale, the sculptor Kenneth Snelson, the architect Buckminster Fuller, and the amateur mathematician Michael Goldberg. In the golden decade following the discovery of the double helix, the development of theories of "spherical" virus structure was driven by experimental data from *Turnip yellow mosaic virus*, *Tomato bushy stunt virus*, and *Poliovirus* as well as by theoretical insights found in art and architecture.

Origin and impact of density gradient centrifugation: A tribute to Myron Brakke. A. O. JACKSON. University of California, Berkeley, CA. Phytopathology 95:S121. Publication no. P-2005-0008-SSA.

The ability to separate and purify macromolecules took a giant step forward more than 50 years ago when Dr. Myron Brakke invented sucrose density gradient centrifugation. Like most scientific breakthroughs, this advance began with attempts to solve a practical problem. In 1947, Dr. Brakke had accepted a position with Dr. Lindsay Black to work on virus purification. This work soon focused on *Potato yellow dwarf virus* (PYDV), which presented a variety of purification problems and could only be assayed by the appearance of chlorotic lesions on inoculated leaves of *Nicotania rustica*. In his initial isolation attempts, Brakke investigated several methods available at the time, but these failed to reveal differences between healthy and diseased tissue extracts. He eventually began to experiment with centrifugation in sucrose solutions and discovered that gradients of increasing concentration permitted separation of a light scattering band containing infectious material. Brakke then developed rate zonal and equilibrium centrifugation in sucrose gradients for purification of PYDV and *Clover wound tumor virus*. He also demonstrated that density gradients containing marker viruses with known sedimentation values could be employed for rapid and precise determination of sedimentation coefficients of unknown viruses. Surprisingly, throughout the 1950's, very few investigators other than virologists applied density gradients for zonal separations, but the early 1960's saw an explosion of applications that have had an unprecedented impact on the biological sciences.

Helen Purdy Beale: The mother of plant virology (and serology). K.-B. G. SCHOLTHOF (1) and P. D. Peterson (2). (1) Texas A&M University, College Station, TX; (2) Clemson University, Florence, SC. Phytopathology 95:S121. Publication no. P-2005-0009-SSA.

Helen Purdy Beale (1893-1976), a pioneer in plant virology, used *Tobacco mosaic virus* to establish tools and concepts in virology, electron microscopy and serology that became standard practice. In 1928-29, Beale reported that serum from rabbits injected with virus sap, from TMV-infected tobacco, had antigenic properties that were not present in normal tobacco sap. In addition the antiserum to virus-sap could completely inactivate virus sap for rub inoculation. Beale used her serological expertise, in collaboration with W. M. Stanley, to define the difference between unique viruses and virus strains, especially taking advantage of the property that virus strains can induce very different symptoms. Stanley wrote that Beale was one of the few investigators in the world who had the ability to "correlate the chemical with the serological work and thus to secure fundamental information regarding viruses in general." The early use of serology and precipitin tests by Beale will be examined in the context of the developments of immunology in the early to mid-20th century.

Insect transmission of viruses: Why paint brushes and Parafilm have remained the tools of the trade. S. GRAY (1), K. Perry (2), and F. Gildow (3). (1) USDA-ARS, Ithaca, NY; (2) Cornell University, Ithaca, NY; (3) Pennsylvania State University, State College, PA. Phytopathology 95:S121. Publication no. P-2005-0010-SSA.

The role of an insect as a vector of a plant virus was discovered in the late 1800s, long before viruses as filterable disease agents were understood and some two decades before insect transmission of human viruses was reported. The next 70 years was dominated by reports of what insect vectored which virus to what plant, but a small innovative ensemble of scientists quietly revolutionized our understanding of the relationships between plant viruses and insect vectors. Unlike animal viruses, most plant viruses did not infect their insect vectors, nor was transmission explained by simple mouthpart contamination or the flying needle analogy. Two seminal concepts emerged, circulative versus stylet borne transmission and virus persistence versus nonpersistence. These discoveries coupled with newly developed in vitro transmission assays and later ultrastructual studies led to an understanding of the virus-vector interactions associated with virus attachment to vectors or circulation through insects. Genetic manipulation of viruses has led to the discovery of specific features of the virus influencing vector-specificity such as, nonstructural helper factors that regulate the attachment of some viruses to the insect stylet and the role of the virus structural proteins in vector tissue recognition. The insect remains a "gray" box, but one being illuminated by a developing insect genomic database. Discoveries on what the insects are contributing to specific virus-insect interactions will play a major role in future research.

Plant pathology and RNAi: A brief history. J. A. LINDBO. Ohio State University, Wooster, OH. Phytopathology 95:S121. Publication no. P-2005-0011-SSA.

RNA intereference (or RNAi) is an RNA-mediated sequence-specific RNA degradation system that functions to down-regulate gene expression in eukaryotes.