# Plant Diseases
# FY 2002 National Program Annual Report



## Introduction

This program addresses the characterization of plant diseases and strategies to control them. The program is divided into five components: identification and classification of pathogens; biological control; cultural control; pathogen biology, genetics, population dynamics, spread, and relationship with hosts and vectors; and host plant resistance to disease. The overall goal of the Plant Diseases National Program is to develop and improve ways to reduce crop losses caused by plant diseases. The program focuses on developing effective control strategies that are not environmentally harmful, do not threaten the safety of consumers, and are compatible with sustainable and profitable crop production. The ARS program is conducted in cooperation with related research in other public and private institutions.

## Selected Accomplishments by Component

### Identification and Classification of Pathogens

<u>New method to survey for citrus canker and other exotic diseases</u>. Previous methods to survey for citrus canker in large commercial situations and in broad residential areas were inadequate. ARS scientists in Fort Pierce, Florida, in cooperation with colleagues at the University of Edinburgh, developed a new method to survey for citrus canker and other exotic diseases, which detects low incidence infections and estimates disease incidence accurately by breaking large areas in to sub-areas and determining the number of samples that need to be collected from each sub-area to achieve a specified level of reliability of detection. The method allows regulatory agencies to survey for disease incidences and is being developed by USDA/APHIS as the basis of an “International Standard For Phytosanitary Measures” for citrus canker detection and other exotic diseases.

<u>Assays developed to identify soybean rust pathogen</u>. Soybean rust is a serious disease problem in many countries throughout the world but is not yet present in the continental United States. If soybean rust were to gain entry into the continental United States and become established, it has been estimated that yield losses could exceed 10 percent in most of the United States and 50 percent in the Mississippi Delta and southeastern United States. ARS scientists in Frederick, Maryland, developed traditional and real-time polymerase chain reaction assays to identify the fungus that causes soybean rust in infected soybeans from Brazil and Paraguay.

This important finding demonstrates conclusively that the highly virulent Asian/African rust species is spreading to new soybean production areas around the world and is coming ever closer to the United States. This information has alerted soybean growers, extension agents, regulatory officials and others to prepare action plans, initiate fungicide registration, and otherwise prepare should the virulent rust species reach the United States.

Scientists confirm identity of exotic daylily disease. A new invasive rust disease from eastern Asia was introduced into the United States and Costa Rica, and is threatening the most important perennial cultivated plant, daylilies. The identity of this rust was confirmed by ARS scientists in Beltsville, Maryland, in cooperation with scientists at APHIS using both morphological and molecular characteristics. This research provides the means for the identification of daylily rust and contributes to the ability to control this invasive fungus.

## Biological Control

Effective measures to prevent transmission of soilborne pathogens. Transmission of soilborne pathogens via irrigation water are a major constraint to growers. To minimize transmission of soilborne pathogens and survival and reproduction of plant parasitic nematodes in soil, ARS scientists in Davis, California, conducted experiments to test ozone as a treatment to inactivate fungal pathogens in recycled irrigation water and to assess the inhibitory activity of *Lysobacter enzymogenes* on plant-parasitic nematodes. Effective doses of ozone for control of pathogen spores in recycled water were identified while *L. enzymogenes* exerted a significant inhibitory effect that reduced survival of nematodes. This work will provide growers with information needed to effectively treat recycled water so that it can be used to safely irrigate crops without spreading disease organisms, and the information obtained on *L. enzymogenes* provides further support for its potential as a biological control agent for plant parasitic nematodes.

## Cultural Control

Suppressive soils reduce root diseases of cereals. Farmers in the Pacific Northwest have been slow to adopt the practice of direct seeding (no-till) wheat and barley because it greatly exacerbates root diseases. ARS scientists in Pullman, Washington, determined the impact on root disease by allowing volunteer cereals and grass weeds to grow in stubble to within a few days of direct seeding before being killed with glyphosate. The volunteer cereals and weeds were shown to serve as a “green bridge” for root pathogens, especially *Rhizoctonia*, and elimination of the green bridge at least one month prior to seeding significantly reduced the damage due to root diseases and significantly increased yield. Farmers now eliminate volunteer cereals and weeds at least one month before seeding, resulting in a significant reduction in root diseases and an expansion of no-till acreage in the Northwest.

## Pathogen Biology, Genetics, Population Dynamics, Spread, and Relationship with Hosts and Vectors

New uncharacterized virus isolated from nursery stock and landscape plantings in Florida. Foliar symptoms suggestive of virus infections were observed in hibiscus nursery and landscape plantings in Florida.  Molecular characterization of the virus was initiated by ARS researchers in Fort Pierce, Florida, in collaboration with scientists at the University of Florida.  This is the first well-characterized tobamovirus known to infect malvaceous hosts, including cotton, okra, and kenaf, which necessitates a revision of the tobamovirus family to accommodate the addition of this new species.

New pathogen of cotton identified in cottonseed.  Viable cottonseed shipped from Australia into California for use in diary cattle feed has potential of introducing damaging wilt pathogens. ARS scientists in College Station, Texas, have identified a *Fusarium oxysporum* wilt pathogen in imported seed from Australia.  Cotton seedlings treated with the exotic fungus were killed in laboratory tests.  On the basis of this work, appropriate detection and control methods can be developed in the United States by regulatory agencies to assure the U.S. cotton industry is protected from this new disease threat.

Important nursery plants screened for Sudden Oak Death susceptibility.  Sudden Oak Death, caused by the fungus *Phytophthora ramorum*, is a disease responsible for the death of thousands of oak trees in California.  As *P. ramorum* has been shown to infect plant species other than oaks, ARS scientists in Frederick, Maryland, have screened nursery and horticultural species of importance to the nursery industry to become familiar with the symptomatology on these hosts and evaluate their susceptibility to Sudden Oak Death.  Susceptibility varied widely among species.  The information is being used by APHIS and state regulatory agencies in designing regulations and planning surveys to detect *P. ramorum* in new areas.

New biotechnological approach to understand how viroids move from cell to cell.  Viroid diseases are responsible for significant losses of food and fiber, but the underlying mechanisms by which viroids move from cell to cell and within the cell during infection are poorly understood.  ARS researchers in Beltsville, Maryland, developed a viral-based vector delivery system to dissect the RNA genome of potato spindle tuber viroid into segments that facilitate nuclear targeting of heterologous RNAs.  This research will improve our understanding of the disease process and could lead to development of methods to disrupt the disease cycle.

## Host Plant Resistance to Disease

Nematode resistant bell pepper hybrids.  Pre-plant soil fumigation with methyl bromide is currently the primary control method for root-knot nematodes in high value vegetable crops, but the imminent suspension of production and importation of this fumigant biocide in the United States (compliant with the U.S. Clean Air Act) has focused much interest on using host plant resistance for managing these nematodes in vegetable crops.  ARS scientists in Charleston, South Carolina, conducted studies at different temperatures to determine if hybrid bell pepper varieties with a dominant resistance gene from only one parent was as resistant as one that received the resistance gene from both parents.  The U.S. Vegetable Laboratory scientists confirmed that resistance from one parent was equal to that from both parents.  This study will expedite the development of root-knot nematode resistant bell pepper hybrids by commercial seed companies; because it showed that only one parent of a hybrid needs to carry the resistance gene to confer high resistance in the offspring.

Genetic Resistance to Reniform Nematodes. Genetic resistance to reniform nematodes represents a means of maintaining high yields while providing a cost-efficient means of controlling reniform population size. Plant species related to upland cotton and carrying resistance to the nematode were hybridized with upland cotton by ARS scientists in Stoneville, Mississippi. Sixteen hybrid plants from 5,000 cultures ovules were recovered from the pollination of upland cotton by *Gossypium arboreum* or *G. herbaceum* despite genetic barriers to hybrid embryo development and fertility that exist between the species of *Gossypium*. These hybrid plants may become the parents of cotton germplasm with resistance to the reniform nematode.

Soybean Cyst Nematode Resistance Identified. The soybean cyst nematode (SCN) is a serious pest of soybean across the southern United States, and public breeders have resistance to SCN as a major breeding objective. ARS scientists in Stoneville, Mississippi, have identified breeding lines that have resistance to one or more of the most prevalent race populations of the SCN. This information will result in publicly developed resistant varieties being released to growers.