National Program 303
PLANT DISEASES
FY 2006 Annual Report

Introduction

The overall goal of National Program 303 – Plant Diseases – is to develop and improve ways to reduce crop losses caused by plant diseases. These diseases reduce yields, lower product quality or shelf-life, decrease aesthetic or nutritional value, and, sometimes, contaminate food and feed with toxic compounds. Control of plant diseases is essential for providing an adequate supply of food, feed, fiber, and aesthetics. Reducing these losses has long been a high priority for agriculture and for the Agricultural Research Service (ARS). Besides the obvious monetary benefits to producers and processors, successful plant health protection is important for maintaining and increasing food supplies with minimal increases in land under cultivation. Additionally, the knowledge and management of plant diseases of quarantine significance are vital, not only for protecting our domestic crops from foreign disease, but also for maintaining and expanding export markets for plants and plant products.

This National Program focuses on developing effective disease 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.

National Program 303 is comprised of four components:

- *Disease Diagnosis: Detection, Identification and Characterization of Plant Pathogens*;
- *Biology, Ecology, Epidemiology, and Spread of Plant Pathogens and their Relationships with Hosts and Vectors*;
- *Plant Disease Resistance*; and
- *Biological and Cultural Strategies for Sustainable Disease Management*.

Together, these components are yielding breakthroughs in understanding and controlling plant diseases and in developing strategies for controlling disease that enhance agricultural value. During fiscal year 2006 this program produced several important discoveries and advances. Some of these are described below, grouped by program component:

<u>Component I – Disease Diagnosis: Detection, Identification and Characterization of Plant Pathogens</u>

The arrival of citrus greening, Huanglongbing, represents a serious threat to citrus production in Florida. ARS scientists at Beltsville, Maryland developed and validated the first real-time and quantitative PCR assay for the greening pathogen. This assay was used by the USDA Animal and Plant Health Inspection Service (APHIS) and the Florida Department of Agriculture to confirm the presence of citrus greening in Florida. Producers will benefit from early detection and genetic improvement for resistance will be accelerated.

Barley and cereal yellow dwarf viruses (five strains), wheat spindle streak mosaic, wheat soil-borne mosaic virus, and wheat streak mosaic virus represent the most economically important group of viruses that infect wheat. ARS researchers at West Lafayette, Indiana, have developed a single, fast test that can simultaneously detect all eight viruses. Development of this assay enables rapid and accurate diagnosis of the cause of wheat disease damage. Producers will benefit from early detection, and genetic improvement for resistance will be accelerated.

Necrotic union disorder, a viral disease, was discovered in California on Pinot Noir grape on 110R rootstock by ARS scientists at Davis, California, in collaboration with scientists from the University of California, Davis. A survey of several vineyard blocks planted to four different Pinot Noir clones documented a disease incidence ranging from 5 to 45 percent, suggesting a rapid spread of the new disease. A research project has been established to identify and characterize the causal agent for the disease and to study the disease development, spread, and effective control measures for this new viral disease.

Component II – Biology, Ecology, Epidemiology, and Spread of Plant Pathogens and their Relationships with Hosts and Vectors

Soybean rust, Phakopsora pachyrhizi, may drastically reduce yields and/or increase production costs for U.S. producers. Since the report of soybean rust in Hawaii in 1994, ARS has renewed its support for soybean rust research. ARS scientists at Ft. Detrick, Frederick, Maryland, screened over 16,000 soybean accessions in the USDA Germplasm Collection located at Urbana, Illinois. These soybean accessions were evaluated for resistance to P. pachyrhizi in Biosafety Level 3 containment greenhouses. The objectives of these evaluations were to identify accessions that may provide new sources of resistance. Many new sources of resistance were discovered. The sources of resistance identified in this research may provide the resistance genes needed for future development of soybean cultivars with soybean rust resistance. This information will be critical to soybean researchers that are interested in sources of resistance to soybean rust.

Phytoplasmas and spiroplasmas cause many agriculturally important diseases of plants, but the development of effective disease control measures is hampered by difficulties in identifying the pathogen’s strains and species. ARS scientists at Beltsville, Maryland identified candidate molecular biomarkers that can distinguish strains and species of these pathogens and that are of potential significance in the survival of the pathogens in their hosts and in the development of plant diseases. This accomplishment provides new knowledge important for understanding mechanisms involved in pathogenicity and transmission of the pathogen by insect vectors.

Component III – Plant Disease Resistance

ARS scientists at Stoneville, Mississippi, have released an advanced breeding line JTN-5503 with resistance to soybean cyst nematode, frogeye leaf spot, stem canker, and charcoal rot. The soybean cyst nematode is a serious pest of soybean in all the soybean production regions in the United States, and public soybean breeders have resistance to this pest as a major breeding objective. The other diseases can also cause significant yield losses. JTN-5503 was grown in nine states in the USDA Southern Uniform Tests program in 2004 and 2005 and was one of the two top-yielding entries in its maturity group. Soybean breeders will use this germplasm line as a parent to develop soybean varieties for soybean producers.

Root-knot nematodes cause severe damage and reduce yields in watermelon in the United States. Watermelon germplasm was evaluated by ARS scientists at Charleston, South Carolina, for resistance to southern root-knot nematode in greenhouse tests. Information on resistance and evaluation methodology was transferred to vegetable seed companies, who have begun screening watermelon germplasm, and to USDA Plant Introductions for resistance to root-knot nematodes. Discovery of resistance to southern root-knot nematode in watermelon germplasm could lead to the development of resistant watermelon varieties, a critical issue due to the restricted availability of methyl bromide as a soil fumigant and the pending loss of other nematicides due to environmental concerns.

Component IV – Biological and Cultural Strategies for Sustainable Disease Management

Fire blight is a serious disease of apple and pear trees caused by a bacterium. ARS scientists at Wenatchee, Washington, utilized new techniques of evaluating beneficial microorganisms on blossoms, the site of primary infections, which led to the discovery of Pantoea agglomerans strain E325, an effective biocontrol agent, and to a patent license agreement with a private company interested in its commercial development. Research cooperation with the company from 1999 to the present led to improvements in fermentation and formulation methods, establishment of effective field rates, and information required by regulatory agencies in the United States and Canada. In September 2006, a formulated product consisting of E325 as the active ingredient was fully registered through the U.S. Environmental Protection Agency, allowing its availability to fruit growers for fire blight management during the spring of 2007 and the potential for improved control of this disease.

Anthracnose is causing increasing damage to U.S. sorghum production and is difficult to combat because there are multiple biotypes of anthracnose. ARS researchers at College Station, Texas, and Mayaguez, Puerto Rico, have employed artificial inoculation methods to identify 12 sorghum accessions in the U.S. sorghum collection that are highly resistant to anthracnose. Characterization of these resistant sources will be crucial to effective management of the disease. Identification of the multiple lines with anthracnose resistance also provides sorghum breeders with critical new germplasm for use in developing needed resistance to anthracnose.