FY 2005 National Program 305 Annual Report

Introduction

The goal of the Crop Production National Program is to develop technologies for crop production that are applicable to small, medium, and large-sized farms in a variety of production systems, e.g.,. organic farming Research includes, but is not limited to, models and decision aids, integrated pest management of multiple pests in a holistic approach, sustainable cropping systems, economic evaluation, automation and mechanization to improve labor productivity, application technology for agrochemicals and bioproducts, sensor and sensing technology, controlled environmental production systems, and worker safety and ergonomics. The program also focuses on all aspects of bees as efficient pollinators and honey producers, as well as their protection and management.

Specific accomplishments made by ARS in FY 2005 crop production research are listed below. For additional information on progress and accomplishments, annual reports for each of the research projects assigned to the Crop Production National Program can be viewed at http://www.ars.usda.gov/research/programs/programs.htm?list421s=true&NP_CODE=305 .

Component I. Integrated Production Systems

Fresh strawberries for fall and winter. Although there is market demand for fresh strawberries in the fall and winter, most current strawberry production methods produce fruit only in the spring. ARS scientists at the Appalachian Fruit Research Station, Kearneysville, West Virginia, have developed a new transplant propagation technique that causes strawberry plants to flower within 4 weeks after field establishment, allowing strawberries to fruit in both the fall and the spring. This propagation technique stretches the picking season to late fall when the price is greatest and also lessens the risk of weather-related crop loss.

Organic production practices for vegetable transplants. Vegetable producers who wish to obtain organic certification must use materials that meet National Organic Program standards. However, information regarding organic vegetable transplant production is lacking. ARS scientists at the South Central Agricultural Research Laboratory, Lane, Oklahoma, determined which systems could best be used to produce organic transplants with characteristics comparable to those produced with use of conventional materials. This information allows producers to grow vegetables that comply with organic principles and practices.

Developing effective integrated pest management strategies for peanut production. ARS scientists at Dawson, Georgia, determined the effect of three plant orientations and three disease management schedules on disease incidence (leaf spot, stem rot, peg, pod, and limb rot, and tomato spotted wilt virus), yield, and grade of peanuts. Plant orientations included single row,

twin row, and diamond patterns. Results showed disease incidence was not affected by planting orientation, however, peanuts planted in twin or diamond orientations produced an average of 650 pounds per acre more than peanuts planted in single rows, although all of the disease management schedules were successful, a fungicide program using the "block calendar schedule" provided the most consistent control of leaf spot and stem rot. Tomato spotted wilt virus was not affected by disease management or plant orientation.

Component II: Agroengineering, Agrochemical, and Related Technology

Chemical-free defoliation of cotton for harvest. When cotton is harvested, inclusion of leaves with the fiber causes staining and excessive trash content, both of which greatly reduce the value of the crop. To prepare cotton for harvest, growers spray the crop with a chemical defoliant to remove leaves. Alternative non-chemical methods of defoliation are needed. ARS scientists at Mesilla Park, New Mexico, have developed a propane-fueled thermal defoliator that causes leaf drop by heating the plants. A prototype two-row unit was built, extensively field tested, and shown to perform well under a variety of conditions. With support from the Propane Education and Research Council, a prototype six-row unit was transferred to the private sector in 2005 for further evaluation. The thermal defoliator has the proven potential for an environmentally friendly means of harvest preparation of cotton. Because it uses no chemicals, it is also suitable for organic cotton production.

Nitrogen improves bare-root nursery tree quality. Defoliants used in commercial production of deciduous, bare-root nursery trees increase the efficiency of harvesting. However, premature leaf fall from use of defoliants decreases plant quality by lowering the amount of nitrogen (N) stored in plants needed for growth the following spring. ARS scientists at the Horticultural Crops Research Laboratory, Corvallis, Oregon, in cooperation with Oregon State University and commercial growers, found that applying nitrogen fertilizer to plant leaves in combination with the use of defoliants effectively defoliates plants while enhancing nitrogen storage, which improves plant performance during the following growing season. These findings allow growers the benefits of early defoliation without reducing plant quality.

Reduced pesticide use in nurseries. Pesticides are used to ensure high quality nursery plants to meet consumer preferences. However, because many nurseries are in populated areas, pesticide contamination of the environment potentially threatens the safety of nearby residents. ARS engineers and scientists with the Application Technology Research Unit, Wooster, Ohio, determined that air blast spraying (a common method of applying pesticides to trees) used more chemical than needed to control pests. They also determined that an excessive amount of spray mixture was lost on the ground and in the air. Recommendations were developed for proper sprayer setting and for correct pesticide-mix application rates. The findings show potential to reduce by one-half the pesticide and water used in nursery applications.

Component III: Bees and Pollination

Honey bee genome sequenced and analyzed. Annotation is the process of taking raw DNA sequence and adding analysis and interpretation to determine its biological significance, i.e., what do the DNA sequences mean? ARS scientists at Beltsville, Maryland, and Weslaco, Texas,

in cooperation with a large international effort, have annotated much of the honey bee genome, which had been sequenced by the Baylor College of Medicine's Human Genome Sequencing Center. The honey bee is the first agricultural and beneficial insect to be sequenced. The annotated genome will be used to improve bee health and pollination efficiency. This effort is crucial, since it comes at a time when the honey bee is being devastated by a variety of invasive parasitic mites (particularly varroa and tracheal mites) and diseases.

Improved bee germplasm for breeding. Eighteen Russian breeder queen lines have been commercially released by ARS scientists in Baton Rouge, Louisiana,. after a decade of testing to identify useful lines. These lines are a genetically diverse group of bees resistant to varroa and tracheal mites that do not show excessive defensiveness or susceptibility to chalkbrood disease. In related work, scientists at Baton Rouge found that bees with the suppressed mite reproduction (SMR) trait removed reproductive mites more often than they removed non-reproductive mites, supporting the idea that resistance is due, in large part, to discriminative hygienic behavior. This information will help bee breeders to develop strains of bees that better deal with varroa mite infestations in hives.

New antibiotic, tylosin, has been approved to control foulbrood disease in bees. The bacterium that causes the devastating bacterial disease of bees, American foulbrood, is showing a widespread resistance to the only antibiotic currently approved for its control. ARS scientists in Beltsville, Maryland, with cooperation from ARS scientists in Weslaco, Texas, conducted research on tylosin with regard to animal safety, effectiveness, and human food safety. These studies have led to the acceptance of tylosin tartrate by the Food and Drug Administration. This approval will provide beekeepers across the United States with a new antibiotic to manage American foulbrood disease and will contribute to maintaining the vitality of the U.S. beekeeping industry.

New management systems for solitary bee pollinators of alfalfa and rasberry. Chalkbrood is a severe fungus disease of bee larvae, and alfalfa leafcutting bees are especially susceptible to it. ARS scientists in Logan, Utah, have demonstrated an easy-to-use method for reducing chalkbrood by treating over-wintering bee cells with fungicide just prior to incubation. Having discovered this new application strategy, new fungicides have a possible utility for alfalfa seed growers who depend on the alfalfa leafcutting bees. These scientists have also demonstrated that *Osmia aglai*, a bee native to Oregon and California, is an effective pollinator of red raspberries.