Crop Production
Fiscal Year 2002 National Program Annual Report

Introduction

The goal of the Crop Production National Program is to develop technologies for sustainable crop production that are applicable to small, medium, and large-sized farms in a variety of production systems. Program outcomes ensure and promote the use of sustainable agricultural production systems, as well as organic farming systems. 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.

Some specific accomplishments made by ARS in its FY 2002 crop production research are listed below. The annual progress reports for each of the research projects assigned to the Crop Production National Program can be viewed at this site to obtain additional information on progress and accomplishments.

Selected Accomplishments by Component

Component I: Integrated Production Systems

Environmentally safe technique controls weeds in blackberries. The number of registered herbicides for small fruit culture has decreased and, alternatively, more environmentally friendly weed control measures are needed for blackberries especially during the establishment year. At the Appalachian Fruit Research Station, Kearneysville, West Virginia, scientists evaluated the efficacy of several techniques for controlling weed competition during the establishment year and found the best weed control and most blackberry plant growth were obtained with use of a kaolin clay particle mulch. This research has identified the use of hydrophobic kaolin clay particle as an environmentally safe new weed management technique that mitigates scarcity of synthetic herbicides for small fruit crops and improves the economic viability of blackberry production.

Decision support system increases profit for peanut growers. Peanut yield, quality, and net farm income depend on optimum and timely management. ARS scientists at the National Peanut Research Laboratory in Dawson, Georgia, developed and released, through a Cooperative Research and Development Agreement with the Peanut Foundation, an integrated decision support system (Farm Suite Version 2.0) that includes computer software for managing irrigated

peanut production (Irrigator Pro), harvesting (HarvPro), capital investment (CIS), sprinkler operation and ownership costs, and curing (PECMAN). Over 100 copies of the software have been distributed as shareware to growers, extension agents, and crop consultants throughout the peanut growing regions of the United States. From New Mexico to Virginia, producers using FarmSuite have optimized irrigation, pesticide applications, and other production factors while enjoying 300 lb/ac increased yields, higher grades, minimal aflatoxin contamination, and $300/ac increased profits when compared to the average peanut grower.

Non-pesticide method is effective in control of significant grape pest. The glassy-winged sharpshooter insect (GWSS) was recently introduced into California, vectoring Pierce's disease, and killing 40 percent of the grape vines in the Temecula Valley over the past three years; it is now spreading to the lower San Joaquin Valley and threatening the California wine and table grape industry. Scientists from the Appalachian Fruit Research Station, Kearneysville, West Virginia, in collaboration with the University of California Extension Service established three large replicated field trials in fields of table grape in Kern County, California, to compare particle film technology with conventional insecticides for preventing GWSS infestation and oviposition in grape. Grapes treated with particle film showed significant reductions in Pierce's disease and citrus crops treated with particle film in the fall had significantly fewer over-wintering GWSS. The particle film, 'Surround WP', is now part of a countywide IPM program that is being implemented in Kern County by the California Department of Food and Agriculture for GWSS control in grape.

Cover crops reduce cotton insect populations by controlling soil nitrogen. A more thorough knowledge of how the ecosystem of agricultural land is affected when cover crops and conservation tillage are used will lead to new and better production systems. Scientists at the USDA-ARS Coastal Plains Soil, Water, and Plant Research Center in Florence, South Carolina, along with collaborators from Clemson University conducted experiments to ascertain how early season insect pests and soil nitrogen supply influence cotton yield and quality following different cover crop species. The results showed that the predominant effect of cover crops on yield and quality was through their influence on the soil nitrogen supply, and the cotton yield and quality loss from early season insect damage generally increased as total nitrogen available to the crop increased. These findings will enable development of sustainable cotton production practices, including improved organic farming methods.

Method for real-time estimate of grapevine yields. Grape growers, juice processors, and wineries need methods for estimating grapevine yield to replace current labor-intensive hand sampling, which provides limited data and only static yield predictions. Scientists at the Horticultural Crops Research Unit, Prosser, Washington, in collaboration with the Washington State University Irrigated Agriculture Research and Extension Center developed a method of using trellis tension and vibration frequencies to estimate crop mass and grapevine yield. They demonstrated that load cells could be used to measure tension in the trellis wire of a vineyard and that this measurement in turn could be used to provide real-time estimates of crop mass. Cost-effective, wireless technology for implementing the load cell system in commercial vineyards provides a highly sought-after alternative technology for yield estimation in vineyards.

Component II: Agroengineering, Agrochemical, and Related Technology

Mechanical harvesting system aids the cherry industry. Higher hand-harvesting costs and shortages of labor necessitated that an economically viable mechanical harvesting system for sweet cherries be developed. An engineer with the Innovative Fruit Production, Improvement and Protection Research Unit at the Appalachian Fruit Research Station in Kearneysville, West Virginia, in cooperation with the Washington Tree Fruit Research Commission developed a mechanical harvester for fresh market quality sweet cherries. The research prototype was extensively tested and demonstrated potential high harvest rates, efficient fruit collection, and fruit quality comparable with commercial hand harvesting. When commercialized, this mechanical harvesting system should reduce both harvesting costs and the cherry industry dependency on unreliable labor supplies.

Methods to improve pesticide application. Producers, consumers, and farm neighbors share common concern about the fate of pesticides as it relates to environmental stewardship as well as food safety. Field experiments have been conducted at the Application Technology Research Unit in Wooster, Ohio, to evaluate means for controlling placement of pesticides with emphasis on providing better quality spray deposits while minimizing off-target contamination. When properly timed, air-assisted spraying techniques provided superior deposition characteristics when compared with conventional, high-pressure applications, which are more prone to producing spray drift. This research has shown fruit, vegetable, and ornamental industries methods for improving placement of pesticides by use of new applicator designs, through minor modifications to existing equipment with minimal expense compared to purchasing new machines.

Comprehensive spray nozzle handbook developed. Because the functional qualities of spray nozzles used in aerial application vary widely as a result of different application requirements, there is need for a comprehensive and standardized assessment of nozzle technology and atomization parameters for reference and use by applicators and by government regulatory agencies. ARS scientists in the Areawide Pest Management Research Unit at the Southern Plains Agricultural Research Center, College Station, Texas, prepared a comprehensive handbook on spray nozzles. The detailed assessment of aerial spray nozzles that are either in use or under development was prepared as a result of an extensive evaluation, which included wind tunnel modeling studies, and in accord with American Society of Agricultural Engineers Standards. This handbook will be valuable to the aerial application industry, and to relevant government regulatory agencies, in efforts to assure that aerial application procedures comply fully with current and proposed Environmental Protection Agency and state regulations with respect to application protocols and spray drift minimization

Better corn rootworm control. The corn rootworm causes about $1 billion in economic losses to U.S. corn farmers each year; improved technology is needed to reduce these losses. Scientists in the Areawide Pest Management Research Unit at the Southern Plains Agricultural Research Center, College Station, Texas, in collaboration with Texas A&M University and Florida Food Products Agrochemicals, developed and tested new application formulations with the goal of improving the effectiveness of a promising rootworm control chemical known as Invite. A specific “Invite” formulation emerged from the work that was much more resistant to the weathering effects of rainfall and which therefore remained toxic to rootworms much longer after application than did prior formulations used. Testing on thousands of acres of corn

confirmed the positive results. This accomplishment will result in better corn rootworm control, at lower cost, and requiring less pesticide; corn farmers will see significant enhancement in corn production efficiency, and higher profits.

Component III: Bees and Pollination

Africanization of European honey bee colonies studied. ARS scientists in Tucson, Arizona, are studying the process that leads to Africanization of European honey bee colonies. Queens inseminated with sperm from equal numbers of European and African drones produced predominately African patriline workers. It is very difficult to requeen Africanized colonies with European queens; therefore, beekeepers cannot manage the genetics of their colonies in areas with Africanized honey bees. These scientists were able to demonstrate that a citronella-based horse rub and DEET neither enhanced, nor repelled, attacking Africanized bees, but that another horse rub, Repel X, increased the number of attacking bees. The impact of this is that Repel X should be avoided in areas of high risk of bee attack, but that citronella based horse rub and DEET are safe.

Artificial diet for honey bees developed. ARS scientists in Tucson, Arizona, have developed an artificial diet for honey bees that can be used as the bee's sole food source. This provides beekeepers with an inexpensive and easy to use artificial diet can help insure strong, populous colonies for pollination.

Blue orchard bee nesting block design results in patent. ARS scientists in Logan, Utah, conducted research on a nesting block design for the blue orchard bee that was inexpensive, durable and easily-sanitized. This research, done in collaboration with a cherry producer in Utah, has resulted in a patent (U.S. Patent 6,364.738 Solitary Bee Nesting Block).

Meadowfoam as a forage crop to increase populations of the blue orchard bee. ARS scientists in Logan, Utah, have completed the second year of a research and demonstration project that uses meadowfoam, an oil-seed crop, to increase populations of the blue orchard bee. This could ultimately lead to zero pollination costs per acre, as well as increased profitability from the sale of surplus bees.

Optimal method for applying antibiotic (tylosin) to control American foulbrood. ARS scientists in Weslaco, Texas, completed research that compared methods for applying tylosin to bee hives: tylosin is a dust with powdered sugar vs. tylosin in a grease patty. The grease patty method was as effective as the dust method, but hives treated with the grease patty experienced significant increases of the damaging small hive beetle.

Russian bees evaluated for resistance to Varroa mites. ARS scientists in Baton Rouge, Louisiana, have shown that honey bees imported from far eastern Russia have a strong genetically-based resistance to the Varroa mite. Russian bees also exhibited a strong resistance to the tracheal mite. In addition, the Russian bee's honey production was as good or better than that of the commercial stocks of honey bees and they exhibited excellent winter hardiness. Also, using a different strategy, one that employs domesticated bee stocks, is showing promise for increasing the frequency of mite-resistant genes. The mite resistant trait was evaluated and

honey bees were found to express a high level of resistance to varroa mites when bees were selected for only one resistant trait, Suppression of Mite Reproduction (SMR). A significant level of mite resistance was retained when commercially reared queens with the SMR trait were free-mated with unselected drones. This suggests that commercial queen producers can produce mite resistant queens by using their traditional methods of queen production.

Fungal pathogen of Varroa mites found to be as effective as pesticides. ARS scientists in Weslaco, Texas, have found a fungal pathogen of Varroa mites to be as effective as pesticides currently in use, and with no adverse effects on honey bees. The commercialization and widespread use of this pathogen could lead to elimination of pesticides in bee hives.