FY 2004

FY 2004 National Program 305 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.

Specific accomplishments made by ARS in its FY 2004 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

Benign chemical used for controlling strawberry runner production. Excessive runner production weakens strawberry plants, reduces branch crown development and consequently yield, and is costly to manage. A multi-year field trial was carried out by ARS scientists in Beltsville, Maryland, to determine the effects of the plant growth regulator, Prohexadione-CA on runner and branch formation in the June-bearing cultivar, Chandler, grown in a cold climate, annual hill system. Prohexidione-CA was effective in reducing fall runners and increasing branch crowns. This growth regulator what has registration to strawberry should provide an environmental benign chemical method for controlling runners and thus reducing labor costs.

Novel weed control strategy for small fruit systems. Because the number of herbicides available for use in small fruit production continues to decline, environmentally friendly alternatives are needed. ARS scientists with the Innovative Fruit Production, Improvement and Protection Research Unit at the Appalachian Fruit Research Laboratory in Kearneysville, West Virginia demonstrated that post-plant application of a hydrophobic kaolin mulch provided excellent weed

control during the establishment year of blackberries with no adverse effects. This research identified a new environmentally safe and economical weed management technique for small fruit and horticultural crops.

Component II: Agroengineering, Agrochemical, and Related Technology

Cone nozzles are gentle to nematodes. There is little guidance available for the effective application of entomopathogenic nematodes (EPN). Engineers and scientists with the Application Technology Research Unit at Wooster, Ohio established that extensional flow conditions such as encountered in flow through flat fan nozzles is more harmful to EPN than the high rotational flow associated with cone nozzles. These findings show practical measures that producers, educators, and equipment manufactures can take to increase the viability of sprayer applied EPN.

Technology to effectively control insects in dense nursery canopies. Nursery growers need sprayers that can apply droplets uniformly within dense canopies commonly associated with healthy marketable plants. Engineers and scientists with the Application Technology Research Unit at Wooster, Ohio modified a five-port air-assist sprayer to obtain improved spray penetration into plants at a production nursery. These findings will help growers to use proper sprayer operation conditions to economically deliver sufficient pesticide to control insects in the inner and lower canopies of nursery plants where they frequently attack.

Component III: Bees and Pollination

Artificial diet of honey bees in new, improved formulation. The development of artificial diets that can enable honey bees to rear broods and increase colony populations is critical for U.S. agriculture and is particularly important in ensuring bees for early season almond production (which uses half of all U.S. bee hives). Scientists in Tucson, Arizona, have reformulated the diet to tap water at room temperature. This new formulation stays in solution indefinitely and is highly palatable to honey bees. It will enable colonies of honey bees to continuously rear brood thus creating healthy populous colonies for pollination.

Detection of deformed wing virus in the United States. Scientists in Beltsville, Maryland have detected deformed wing virus in honey bees and in parasitic mites of honey bees. This virus has never been detected in the U.S. and may provide an answer to previously unexplained honey bee colony losses. In addition, the detection of the virus in bee stages not associated with mite parasitism suggests that non-mite transmission may be alternative way for the virus to spread within colonies.

Queen bees inseminated with low viability semen function well for one summer. Scientists in Beltsville, Maryland, have shown that honey bee queens inseminated with low viability semen will function as well as normally inseminated queens for at least one summer season. Queen breeders using stored semen to reconstruct selected stocks would normally expect to use an inseminated queen for only one summer.

Rain amounts may limit the spread of the Africanized honey bee. Scientists in Tucson Arizona, have found a correlation between an evenly distributed rainfall of more than 55 inches per year and an almost complete halt to the spread of the Africanized honey bee. By considering the 55-inch rainfall limit, regulatory vigilance could contain the spread of these invasive species in niches of southern California and southern Florida that would be hospitable to the bees.

Varroa free hybrid bee a possibility. Although the SMR (suppress mite reproduction) trait is very effective in controlling varroa mites, scientists in Baton Rouge, Louisiana, noticed that colonies with high levels of SMR trait sometimes had poor brood production. Through research, they found, however, that there was no relationship between the SMR trait and poor brood production. The results of their study suggest that it should be possible to produce a hybrid bee with good beekeeping qualities that is virtually free of varroa mites. The study also suggests that two genes control the SMR trait.

First steps in development of conceptual model of honey bee stress response. Using information from the honey bee genome, ARS scientists from Weslaco, Texas, have identified a new receptor in the bee. This is important because it will allow development of a conceptual model of how honey bees respond immunologically to different stressors, including diseases, adverse environmental conditions, etc.

High temperature may limit survival of spores contributing to disease of alfalfa leafcutting bees. Scientists in Logan, Utah, while determining the thermal limits for chalkbrood fungus growth and spore germination, found that spores germinating at higher temperatures soon die. Continued research in this area suggests that one or more temperature stress responses may have the added benefit of acting as a defense against pathogen invasion (perhaps through the induction of prophenol oxidases that are associated with the immune response in insects). This will have a direct impact on the development of disease management protocols in commercial scale alfalfa leafcutting bee populations.

Increased resistance to varroa mite with Russian honeybees separated from susceptible stock. In FY 2004 scientists in Baton Rouge, Louisiana, studied the effects of co-mingling varroa mite resistant bees with susceptible Italian stocks. They found that Russian honey bee resistance to varroa mites is enhanced in apiaries having only Russian colonies. The susceptible stock apparently served as a source of infestation for the entire apiary. This knowledge will provide important guidance for beekeepers exploring the value of resistant stocks in their individual breeding environments.