United States Department of Agriculture
Agricultural Research Service

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Updated August 2006

Beltsville Agricultural Research Center

Current Research IMPACTS

IMPACTS WITH NATIONAL COMPANIES

- Honey bee-assisted pollination adds about $15 billion/year in value to U.S. agricultural production. Honey bee populations, however, have been declining as a result of parasites and diseases. *BARC developed a screened bottom board insert for bee hives that helps reduce the number of parasitic Varroa mites* (available from several commercial suppliers) and recently received FDA approval for an antibiotic to control a devastating bacterial disease of bees (American foulbrood). This antibiotic is being marketed by *Elanco Animal Health, a division of Eli Lilly & Company*.

- An agreement with *McCorkle Nursery (Dearing, GA) and Kerry's Bromeliad Nursery (Homestead, FL)* is leading to new *technologies to control color in leaves, flowers, and fruit*. It will yield novel plants with an estimated $160 million/year market for the greenhouse and nursery industry.

- Viruses cause some of the most important diseases of most crop plants, but especially vegetatively produced ornamental crops. BARC developed, patented and licensed to *Agdia, Inc. (Elkhart, IN)* a single antibody for the broad-spectrum detection of one of the most economically important group of plant viruses, *potyviruses*. This antibody-based test kit is being used in over 115 countries world-wide to screen field and greenhouse crops as well as new cultivars before they are put into commercial production. A current agreement with *Agdia, Inc.* is leading to the development of other broad-spectrum reagents and tests for the detection of several other important plant virus groups.

The Beltsville Area of USDA's Agricultural Research Service encompasses programs at the Henry A. Wallace Beltsville Agricultural Research Center (BARC) in Beltsville, Maryland; the U.S. National Arboretum in Washington, D.C.; and worksites in Chatsworth, New Jersey; Presque Isle, Maine; and McMinnville, Tennessee.

The Henry A. Wallace Beltsville Agricultural Research Center is the largest and most diversified agricultural research complex in the world. Beltsville's record of accomplishments and ongoing programs has made it a world leader in agricultural research. Its international reputation attracts thousands of visitors each year from the United States and abroad.

Research in the Beltsville Area is conducted through programs at the U.S. National Arboretum, Animal and Natural Resources Institute, Beltsville Human Nutrition Research Center, and Plant Sciences Institute.

ARS USDA

U.S. National Arboretum

The U.S. National Arboretum's mission is to conduct research; provide education; and conserve and display trees, shrubs, floral, and other plants to enhance the environment. The arboretum is both a research facility and a living museum. It is dedicated to serving the public and improving our environment by developing and promoting improved landscape plants through scientific research, educational programs, display gardens, and germplasm conservation. The arboretum is a unique federal institution linked by partnerships to other governmental agencies, the scientific community, other arboreta and botanical gardens, and various private sector groups. It is a national center for public education that welcomes visitors in a stimulating and aesthetically pleasing environment.

Animal and Natural Resources Institute

The Animal and Natural Resources Institute's mission is to conduct research and develop technology transfer programs that ensure high quality and safe food while protecting the natural resource base and the environment. The scope of research is diverse, including ways to prevent, control, or eradicate parasitic infections in animals; determine the fate and transport of nutrients, pathogens, agrochemicals, and other potential pollutants in the environment; develop practices to support the achievement of sustainable agroecosystems; improve the accuracy of genetic evaluation procedures for economically important traits of dairy animals; solve water management concerns; develop knowledge of the structure and function of the genomes of livestock in order to improve the genetic, reproductive, and food productive efficiency; and enhance the quality and safety of food products.

Beltsville Human Nutrition Research Center

The mission of the Beltsville Human Nutrition Research Center is to define, through research, the role of food and its components in optimizing human health and reducing the risk of nutritionally related disorders in the population. Scientists at the center conduct research toward understanding how dietary components interact with genetic, physiological, sociological, and environmental factors to affect the health of the U.S. population so diversified by ethnicity, gender, lifestyle, and environment.

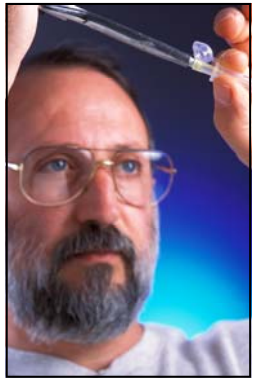
Plant Sciences Institute

The mission of the Plant Sciences Institute is to conduct research to study biological, chemical, and physical processes and principles, including bioregulation, that will lead to new technologies and scientific discoveries in support of agriculture. The scope of research includes improving pest management systems, food quality and safety, crop quality and production efficiency, conservation of natural resources, and environmental quality; support of regulatory and action agencies; responding to research needs identified by farmers and other stakeholders; and contributing to advances in biotechnology, bioinformatics, and other benefits to society. The institute's mission is accomplished through complex fundamental and applied research programs and technology transfer activities.

The *chicken processing industry* processes over 8.5 billion birds/year, valued at $24 billion. Every bird must be inspected. To bring food safety and quality inspections to a new level, BARC scientists

developed two optical vision systems that automatically inspect individual birds for diseases and physical defects on the processing line. The systems can handle line speeds of up to 180 birds a minute, and can be implemented at either evisceration or kill lines. These systems are now being transferred through an agreement to *Stork-Gamco Inc. (Gainesville, GA)* for commercial development. These systems are also being developed for chicken feet inspection for the export market that is valued at about $200 million annually.

A patent has been applied for and another issued for an immunomodulator known as CD14, a protein that enhances cure rates for *Escherichia coli* mastitis. A license has been issued to and an agreement developed with the *Monsanto Company (St. Louis, MO)* for production, research, and possible marketing of CD14.



BARC scientists have developed novel mechanisms to prevent and control mastitis, a disease responsible for $2 billion in annual economic losses to the dairy industry. Specifically, BARC scientists

have developed and obtained a patent for an effective vaccine against *Staphylococcus aureus*, the leading cause of mastitis worldwide. Further, BARC scientists have established an agreement with *Pfizer, Inc. (New York)* to evaluate another preventative *S. aureus* vaccine.

IMPACTS WITH NATIONAL COMPANIES

- A *multi-use soybean cultivar 'Tara'* was bred for increased crop residue. The six-foot tall Tara, the first of a new generation of soybean cultivars, was bred, tested, released, protected under Plant Variety Protection, and licensed to *Southern States Cooperative (Richmond, VA)* for marketing to farmers. Tara provides 72% more crop residue after grain harvest than conventional cultivars. This crop residue has been estimated to reduce soil erosion by 210 million tons per year and to save up to $325 million dollars in costs for water purification and for the dredging of lakes and rivers if used on all soybean acreage nationally. Tara is now being used by farmers on several thousand acres.

- BARC scientists have bred *forage soybean* cultivars Tyrone and Tara which were licensed to *Southern Sates Cooperative (Richmond, VA)* for marketing to farmers. These cultivars have been planted on over 100,000 acres in the U.S.

- The removal of metals from soils - *phytomining* - using improved natural metal hyperaccumulator plants is being increasingly used to both remediate contaminated soils and to produce alternative nickel ore. Soils contaminated by mining, smelting, etc., can be cropped with these plants, which were discovered by BARC scientists, and made into hay; the hay can be burned for biomass power generation, and the ash is an excellent ore for low cost production of nickel metal. Land in Oregon is being commercially phytomined, and these plants have been grown effectively on nickel-contaminated sites in four countries by a $5 million joint venture of *Viridian Development Company (Houston, TX) and Inco Limited (Toronto, Canada)*.

Current BARC Research Impacts...

... ON AGRICULTURAL COMMODITIES

... ON ANIMAL PRODUCTION AND HEALTH

... ON HUMAN HEALTH AND NUTRITION

... ON THE CHESAPEAKE BAY

... ON BIOBASED PRODUCTS

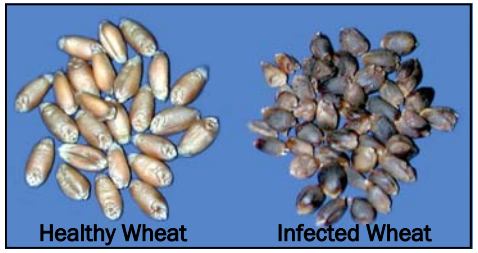
... ON GLOBAL ISSUES

... ON OTHER GOVERNMENT AGENCIES

... WITH MARYLAND COMPANIES

... WITH NATIONAL COMPANIES

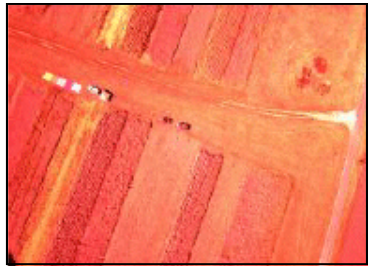
U.S. wheat exports to Brazil were rejected in 2000 because of suspected Wheat Seed Gall Nematode infections. BARC nematologists, working with Brazilian scientists, determined that WSG nematode was last reported in the U.S. in 1975 and that WSG nematode had been reported from Brazil previously. These findings convinced Brazil to reverse its actions. Wheat exports to Brazil rose from $0 in 2000 to $76 million in 2001.



BARC scientists, working with industry counterparts, discovered a fungus that inhibits a devastating disease on cacao trees. The $8.6 billion ***U.S. chocolate industry*** depends entirely on imported chocolate. The chocolate industry uses 40% of US almonds, 20% of peanuts, 8% of sugar, and more than 1.5 million lbs. of milk per day, all produced by U.S. farms, so a stable supply of chocolate helps U.S. farmers.

Floral and nursery plants are an $8 billion industry nationwide and the second largest sector in Maryland agriculture at $304 million/year. The U.S. National Arboretum, part of BARC, has ***developed and released 650 cultivars*** to this industry, including 14 Gold Medal Winners. These include azaleas, winter-hardy camellias, crape myrtle, American elms resistant to Dutch elm disease, red maples, viburnums, shrub roses, flowering cherries and crabapples, and the commercial forms of chrysanthemums, poinsettias, Easter lilies, New Guinea impatiens, and dual-use ornamental/culinary peppers.

AeroView International is a new company in Bowie, MD that uses methods developed by BARC research for flying unmanned aerial vehicles (UAVs) to obtain high-resolution, remotely-sensed imagery for precision agriculture. Within 18 months of contacting BARC, AeroView International began taking orders for UAV flights and is franchising the technology to other companies.



Blue, green, red/near-infrared digital photo at BARC's Farming Systems Project

An agreement with ***Intralytix, Inc. (Baltimore, MD)*** serves as the basis for research on using bacteriophages as a spray for fresh-cut fruits and vegetables to prevent growth of human pathogens. Efforts continue with Intralytix to commercialize the technology developed. Testing needed for FDA approval is pending. Fresh-cut produce sales in the U.S. are estimated at $9-12 billion/year. Foodborne illness costs the U.S. economy $20-40 billion/year.

CR Daniels, Inc. (Dandux) of Ellicott City, MD is manufacturing an ARS-developed tick control device that kills ticks on deer and is safe to use in suburban areas. BARC showed the effectiveness of the device for reducing by more than 40% the population of deer ticks that cause Lyme disease. More than 12,000 cases of Lyme disease are reported annually.

- BARC collaborated with NASA and *Spectrum Mapping (Easton, MD)* to develop an airborne imaging system that serves as the core of the company's remote sensing business.

- BARC entered into a three-way agreement with the Navy and *Creatv MicroTech (Potomac, MD)* to develop a biosensor for the detection of a wide range of food- and water-borne human pathogens. A prototype instrument has been developed and pathogen-specific assays are currently being optimized.

- BARC scientists, in collaboration with Hood College, developed a method to produce methanol from sugar-beet waste. They are now working with the University of Maryland on optimizing the fermentation process. This will be the first cost-effective system to produce biomass methanol, and it will be commercialized through an agreement with *Atlantic Biomass, Inc. (Frederick, MD)*.

- BARC-U.S. National Arboretum scientists obtained six patents on use of *Neem oil* to control insect pests and pathogens on plants and obtained an EPA approved registration for non-food uses. The product was licensed as Green Light Products to *Certis USA (Columbia, MD)*. The market for organic pest control and biopesticides is about $15 million/year in the U.S.

- BARC entomologists confirmed to Mexican officials the presence of several pests of *peaches in Mexico*. This finding kept the export market for peaches to Mexico open and preserved a multi-million dollar market for peach growers.

- BARC entomologists identified a new insect found on *avocados in Mexico*. This work made it possible for Mexican growers to continue to ship millions of dollars of fresh avocados to U.S. markets because the insect was not a threat to U.S. agriculture.

- *Crape myrtles* are one of the most popular woody landscape plants in the southeastern U.S., with approximately 2 million plants sold annually with a value in excess of $30 million. The U.S. National Arboretum has released 31 crape myrtle cultivars, including 24 interspecific hybrids with outstanding tolerance to powdery mildew. These cultivars represent a broad range of flower color, growth habits, and bark characteristics, and account for at least half of the crape myrtles sold in the U.S.

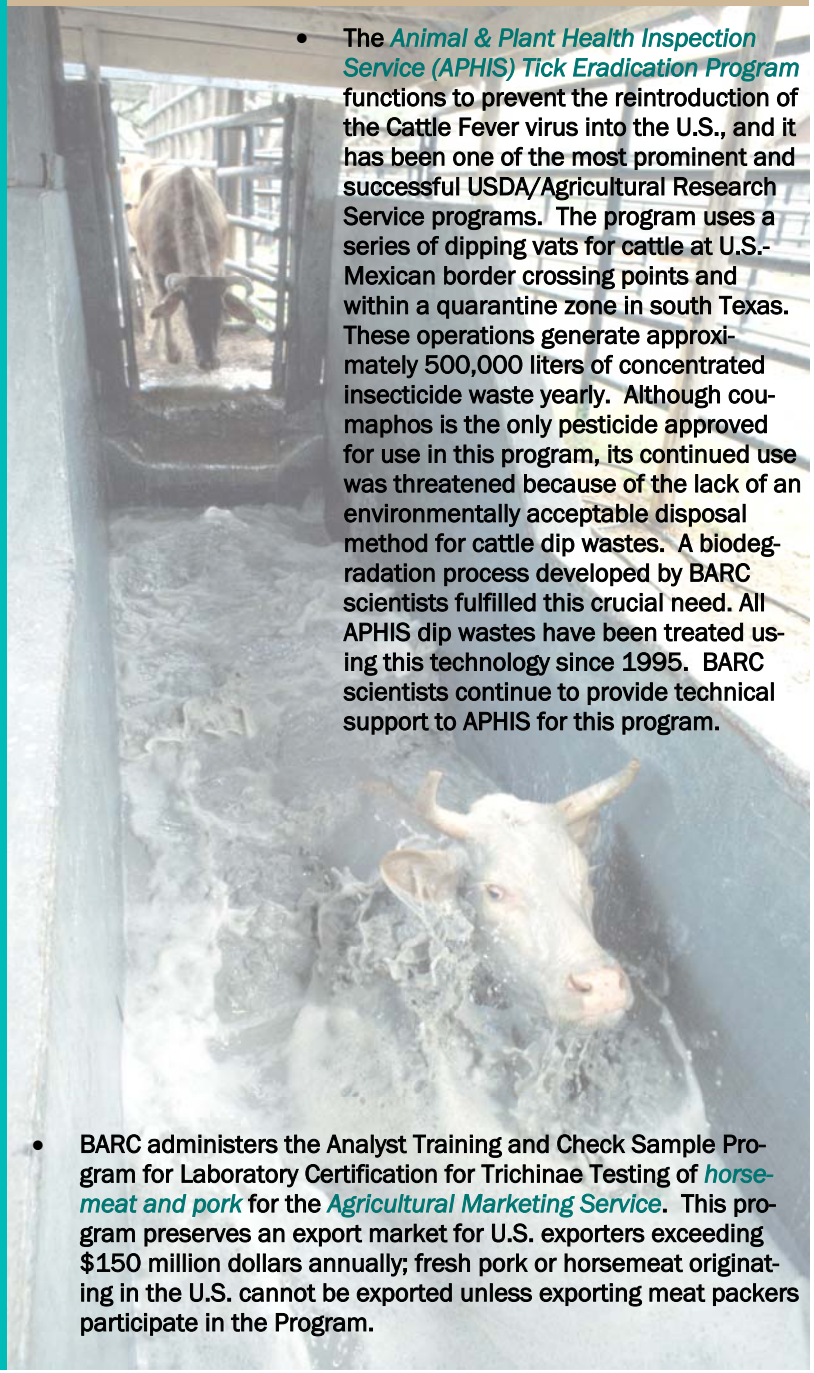
- A recent *pepper release, "Black Pearl,"* with both ornamental and culinary value, won the 2006 All-American Selections Award. This pepper is licensed to *Pan American Seeds, Inc. (Chicago, IL)*. Nurseries and mass-marketers like *Home Depot* are selling Black Pearl, with an estimated market size of $3 million/year.

- Entomologists from the Systematic Entomology Laboratory identified med flies in shipments of Spanish Clementine oranges. This finding resulted in the *suspension of imports of Spanish Clementine Oranges* to the U.S., costing shippers millions of dollars in lost sales, but protecting U.S. crops from further invasion by med flies. Establishment of med flies in the U.S. would not only result in millions of dollars in crop losses, but create barriers to the export of U.S. produce.

- The USDA's Citrus Quarantine Facility is at BARC. Research on citrus diseases in the U.S. is limited to areas of the country which are far removed from citrus growing regions and to highly specialized plant quarantine and containment facilities. The BARC facility is located more than 900 miles away from any known commercial citrus growing region. A U.S. patent has been awarded for the development of improved detection methods for *Citrus Bacterial Canker Disease*. This assay was used to help eradicate the disease in Florida at a cost of ca. $70 million.

- *A single nematode cyst isolated in an Idaho potato field* was identified as potato cyst nematode, not previously known to occur in the U.S. The unequivocal identification, made by a BARC scientist, *enabled the Animal & Plant Health Inspection Service (APHIS) to quickly initiate a quarantine* to restrict distribution of the nematode. At stake is a crop with a $1 billion farm gate value in the region, generating a $5 billion economic contribution. Unchecked movement of the nematode would cause a severe economic impact to potato growers. Canada, Japan, and Mexico had already moved to restrict U.S. potato imports from the infested fields.

- BARC scientists, using national food survey data, assessed the *dietary patterns of the population*, including consumption of added sugars, soda, milk, other beverages, and fast food. The research findings have been *used by federal policy makers such as the Year 2005 Dietary Guidelines Advisory Committee, the FDA Working Group on Obesity, the National Dairy Council 3-A-Day Program, advocacy groups such as the Center for Science in the Public Interest*, and many national and international press.



- The *Animal & Plant Health Inspection Service (APHIS) Tick Eradication Program* functions to prevent the reintroduction of the Cattle Fever virus into the U.S., and it has been one of the most prominent and successful USDA/Agricultural Research Service programs. The program uses a series of dipping vats for cattle at U.S.-Mexican border crossing points and within a quarantine zone in south Texas. These operations generate approximately 500,000 liters of concentrated insecticide waste yearly. Although coumaphos is the only pesticide approved for use in this program, its continued use was threatened because of the lack of an environmentally acceptable disposal method for cattle dip wastes. A biodegradation process developed by BARC scientists fulfilled this crucial need. All APHIS dip wastes have been treated using this technology since 1995. BARC scientists continue to provide technical support to APHIS for this program.

- BARC administers the Analyst Training and Check Sample Program for Laboratory Certification for Trichinae Testing of *horsemeat and pork* for the *Agricultural Marketing Service*. This program preserves an export market for U.S. exporters exceeding $150 million dollars annually; fresh pork or horsemeat originating in the U.S. cannot be exported unless exporting meat packers participate in the Program.

Exports of the ***Maine seed potato*** crop to Canada were threatened because Canadian officials determined that the potatoes were infested by ***viroids***. Viroids, a unique life-form, were discovered at BARC, so Canada agreed that if BARC experts found no viroids, they would allow export of the potatoes into Canada. No known or new viroids were found in the potatoes, thus saving a $5 million/year seed potato market for Maine farmers.

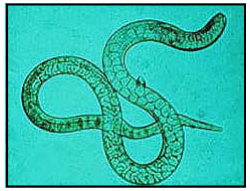
The ***elm and red maple*** occupy prized niches and broad distribution in the American landscape and are highly valued by the nursery industry. Breeding and selection at the U.S. National Arboretum, a part of BARC, have led to the introduction of ***ten Dutch elm disease-tolerant elm cultivars; six red maple cultivars with symmetrical forms, long lasting fall color, and insect tolerance*** also have been introduced. Shade trees are a more than $500 million/year market in the U.S.

- BARC scientists produced *cloned genetically engineered cows* resistant to infection by one of the most contagious mastitis causing pathogens, *S. aureus*. Mastitis, a bacterial infection of the mammary gland, costs the dairy industry $2 billion annually. This is the *first demonstration of using genetic engineering to protect a production animal against an economically important disease*.

- The *National Retail Meats Survey* collected 6,282 samples (2,094 each of beef, chicken, and pork) from 698 randomly selected retail outlets in 28 major geographic areas in the U.S., and determined that viable T. gondii was present in only 0.4% of retail pork samples, and 1.5% of chicken samples were seropositive, indicating exposure to T. gondii. The National Retail Meats Survey was the first study where prevalence of a pathogen in animals has been directly linked to consumer risk in the retail meat case and is a model for future risk assessment of pathogens from farm to table.

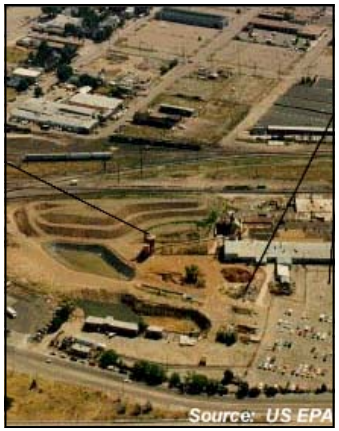
- Pork production systems that *reduce the risk of exposure to Toxoplasma* infection were described and tested by scientists at BARC. Based on audits of swine management practices, a set of good production practices (GPPs) were established. The developed technology consisting of a pre-harvest food safety plan was delivered to the cooperator, and the information was made available for use by the entire swine industry through the *National Pork Board*.

BARC collaborated with the *Canadian Food Inspection Agency* to provided the data necessary to fully validate Trichinella detection protocols to meet international import standards proposed for all countries, with an economic impact of $500 million annually, and established a bank of international reference serum standards for use in the *harmonization of serological assays for trichinellosis in swine and horses under World Organization for Animal Health guidelines*.



IR-4, a consortium of laboratory and field efforts, supports producers of "minor crops" (those not in the top ten) by providing data for the *Environmental Protection Agency* registration of *pest management tools for minor crops*. The estimated potential loss avoidance for Maryland agriculture alone as a result of the availability of these products is $23 million.

Soils at *Environmental Protection Agency Superfund Sites* are commonly contaminated by metals from mine wastes or smelter emissions. Soil removal and replacement is prohibitively expensive for remediation of these sites. BARC scientists demonstrated methods that use combinations of biosolids rich in iron and phosphorus, and alkaline byproducts to make a mixture which can achieve persistent remediation of long-barren contaminated sites. Field demonstrations have shown that the diverse vegetation of re-vegetated sites is safe for wildlife and soil ecosystems. Effective soil remediation using this method costs $3,000-5,000/acre, much less than the $200,000 to 1,000,000/acre for soil removal and replacement.



- When the U.S. was accused of biological warfare by Cuba, Cuba alleged that the U.S. was dropping insect pests (*Thrips palmii*) on its sugar cane crop. BARC scientists, at the request of the *State Department*, traveled to the UN in Geneva, Switzerland, and showed that the insects had arrived in Cuba at a predictable time, as they were blown north through the Caribbean by prevailing winds.

- The first protocol for monitoring a total chemical transport flux in an undisturbed field soil was developed by BARC scientists in collaboration with the University of Wisconsin, Purdue University, and Cornell University. The *Nuclear Regulatory Commission* is using this approach to evaluate chemical transport times on fields similar to radioactive waste disposal sites.

- An audit and verification system to limit risk of exposure of swine to infection was developed by BARC scientists to allow swine to be certified free from *Trichinella* spiralis infection on the farm. Regulatory language has been finalized by *Food Safety Inspection Service*, and The National Trichinae Certification Program will be opened to producers on a national scale. This work represents the official launch of *the first animal production food safety program in the U.S. and meets or exceeds new EU standards for imported pork to be certified Trichinae-free*.

- BARC scientists *identified a new species of parasite called Neospora as the cause of up to 60% of abortions in dairy cattle*. They then defined the life cycle of the parasite, which can be spread by dogs and wild canids like foxes. Knowledge of the parasite's lifecycle helps in its control.

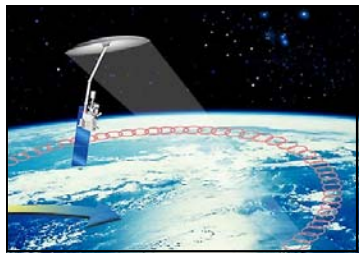
- BARC scientists collaborated with Israeli scientists to develop an early feed restriction *management technique which improves feed efficiency and promotes improved health in meat-type chickens*. An independent economic analysis conducted by the U.S./Israel Binational Agricultural Research and Development group projected that this research will have an economic impact of $187 million through 2010.

- The Animal Improvement Programs Laboratory provides *genetic evaluations of 19 million U.S. dairy cattle* quarterly to the dairy industry worldwide for direct use in selecting parent animals of future generations. *The average rate of genetic increase of 200 pounds of milk per year for U.S. dairy cows is a major factor in keeping the cost of dairy products low*. Domestic sales and exports of semen, embryos, and animals also are enhanced, which positively impacts the U.S. balance of trade. A more efficient national herd can provide dairy products from a smaller cattle population, thus reducing adverse environmental impacts and conserving natural resources.

- BARC scientists developed a robust method for measuring individual *trans fats in foods*. This method has a broad use in food analysis and subsequent labeling of foods. The method made possible BARC research in humans showing that trans fats raise serum cholesterol, leading to the recent FDA requirement for food labels to show trans fatty acid content.

- Scientists at BARC led research that provided a method for testing the efficacy of Trichuris suis egg consumption as a new therapeutic treatment for a serious human illness, *inflammatory bowel disease (IBD)*. In clinical trials, consumption of T. suis eggs significantly reduced inflammatory pathology in IBD patients and in patients with *Crohn's Disease*. The treatment is currently being tested in collaboration with Ovamed GmbH, Inc. (Germany); Ovamed GmbH, Inc. has applied to the FDA for approval for use of the treatment in the U.S.

- An agreement with Hepalife Technologies, Inc. (Vancouver BC, Canada) investigated the potential use of BARC-developed porcine hepatic stem cells in a *bioartificial liver device*. Ultimately, such a device will be used to increase the life expectancy for many of the *25 million Americans who suffer from liver disease*. This collaboration aids in the development of an alternative use of a biological resource developed from farm animals.

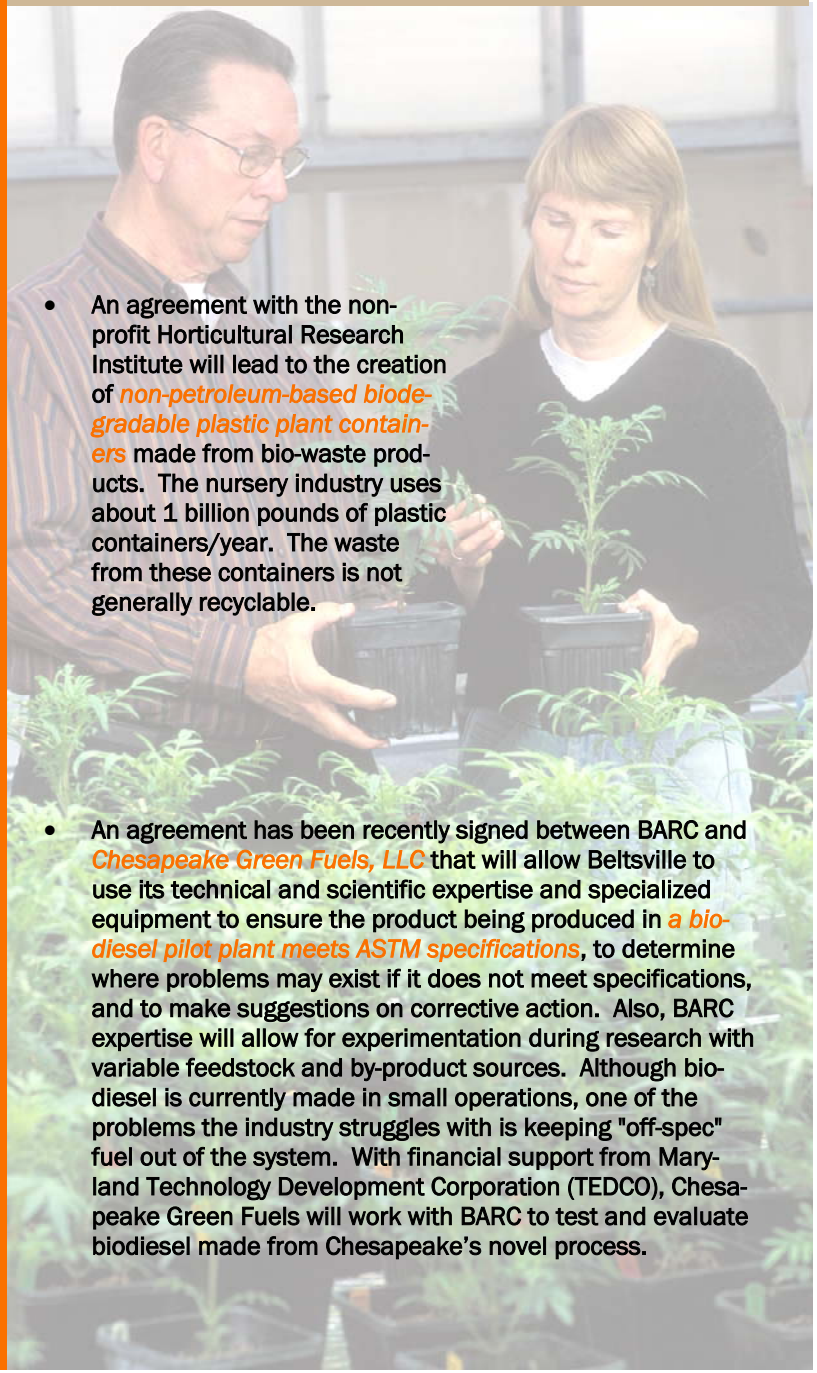


Conclusions from an extensive soil moisture research program conducted by BARC scientists supported a satellite-based implementation of global soil moisture mapping to ***improve future weather predictions***. These results elevated the importance of soil moisture measurement within NASA's Earth Science Program. As a result, NASA selected a soil moisture mission (Hydros) as part of its Earth System Science Pathfinder satellite program, which is scheduled for launch later this decade.

Amphibian population declines are occurring on a global scale. BARC scientists are working with wildlife biologists from U.S. Geological Survey and National Park Service to protect the endangered, alpine, mountain yellow-legged frog, *Rana muscosa*, in the Sierra Nevada Mountains. BARC scientists are investigating atmospheric sources of pesticides that are suspected factors in the decline of these frogs. This work has prompted implementation of new pesticide use practices in California limiting the use of cholinesterase-inhibiting chemicals.

The ***wheat export market to Algeria*** was preserved when a BARC scientist flew there at short notice in 2005 to examine wheat held in port. Algeria claimed the 19,000 tons of durum wheat were contaminated with Karnal Bunt, thereby blocking all wheat U.S. imports into the country. The scientist, the world expert on Karnal Bunt, was able to convince Algerian officials that there was no Karnal Bunt present, allowing the shipment to be unloaded and preserving a $70 million/year market for U.S. wheat.

IMPACTS ON BIOBASED PRODUCTS



- An agreement with the non-profit Horticultural Research Institute will lead to the creation of *non-petroleum-based biodegradable plastic plant containers* made from bio-waste products. The nursery industry uses about 1 billion pounds of plastic containers/year. The waste from these containers is not generally recyclable.

- An agreement has been recently signed between BARC and *Chesapeake Green Fuels, LLC* that will allow Beltsville to use its technical and scientific expertise and specialized equipment to ensure the product being produced in *a biodiesel pilot plant meets ASTM specifications*, to determine where problems may exist if it does not meet specifications, and to make suggestions on corrective action. Also, BARC expertise will allow for experimentation during research with variable feedstock and by-product sources. Although biodiesel is currently made in small operations, one of the problems the industry struggles with is keeping "off-spec" fuel out of the system. With financial support from Maryland Technology Development Corporation (TEDCO), Chesapeake Green Fuels will work with BARC to test and evaluate biodiesel made from Chesapeake's novel process.

- BARC scientists developed and demonstrated methods to ***reduce the risk to children from high-lead urban soils*** where lead had accumulated from automotive and paint sources. Composted biosolids rich in iron and phosphate react with soil lead to make the lead have low bioavailability to plants or children who ingest soil. These methods were demonstrated in inner-city ***Baltimore*** as effective and inexpensive (5-10% of the cost of soil removal and replacement). The high fertility of biosolids compost aids in growth of strong turf grass and reduces children's access to soils they could ingest.

- ***Functional foods*** with enhanced nutritional value are sought by consumers, but health claims on food labels must be based on scientific data to obtain FDA approval. ***BARC did research to show that Take Control™ Margarine containing special plant sterols can reduce cholesterol in adults with moderately elevated serum cholesterol.*** Sales of this margarine are about $14 million/year.

- Through an agreement with outside investors, BARC scientists have further evaluated the ***potential benefits of cinnamon extract on enhancing insulin response in pre-diabetic subjects***, with a potential benefit to many overweight individuals.

Identifying cinnamon compounds that improve the action of insulin

IMPACTS ON HUMAN HEALTH AND NUTRITION

- To further explore why dairy products may enhance weight management and weight loss, BARC scientists are *evaluating whether a component of milk, whey protein, is the causative factor and may help maintain lean body mass and decrease body fat*. Whey is a byproduct of cheese production and its use in weight management products could increase its export value from the 2005 level of $223 million.

- BARC scientists evaluated *Barley as a source of beta-glucan*, a fiber component, in human volunteers. The results showed that blood cholesterol levels were lowered after six weeks of consuming an amount equivalent to a bowl of hot barley cereal per day. These findings were used as the primary human study evidence upon which *FDA approved a petition to permit a health claim on barley* food product labels that consumption of these foods can reduce the risk of coronary heart disease.

- *Accurate estimates of food intake* are critical to be able to determine potential exposure to unintentional food additives and to pesticides, as well as to estimate nutrient intake. Due to the world-wide recognition of the methods developed by BARC scientists that are used to obtain accurate estimate of food intake, the World Bank is sponsoring the training of Russian statisticians to learn the Automated Multi-Pass Method for estimating food and nutrient intake that was developed by the Food Surveys Research Group at BARC.

- Soils research at Beltsville led in the evaluation and ultimate adoption of the *pre-sidedress soil nitrate test (PSNT) in Nutrient Management Programs* within the Chesapeake Bay watershed. Nitrogen fertilizer is an energy-intensive input in agriculture and one that has nearly doubled in price over the past year. The PSNT has been used in Maryland since 1992 on 25,000 to 40,000 acres annually, resulting in average savings of 25 to 40 lbs. Nitrogen per acre compared to common practices. *Use of the PSNT in Maryland alone has translated into a savings of over 14 million lbs. of fertilizer nitrogen, worth over $5 million, with concomitant reductions in nitrogen losses to the Chesapeake Bay.*

- In the Chesapeake Bay watershed, *dairy cattle* produce about 200 million pounds of nitrogen annually which is about equal to that from the Bay's 16 million residents. Nitrogen is an essential nutrient for crops and animals, but too much nitrogen in feed, or in the fertilizer and manure added to crops, can increase nitrogen losses to groundwater, surface water, and air. Scientists at BARC and Cornell University developed a website (www.DairyN.cornell.edu) designed to help farmers, extension agents, and others with managing nitrogen from dairy cattle operations. *By using the nitrogen management strategies described in the website, dairy farmers could conserve about 40 million pounds of nitrogen annually, with potential economic savings of $14 million and reductions of nitrogen losses to the environment.*

IMPACTS ON THE CHESAPEAKE BAY

- A new production system developed at BARC increased profitability of fresh-market tomato production by $3900/acre, equal to $7.8 million increased profit for Maryland tomato producers, while *reducing soil sediment loss by 85% and pesticide loss by 75-90% into the Chesapeake Bay.*

- As part of efforts to improve the health of the Chesapeake Bay, BARC scientists have partnered with the Natural Resource Conservation Service, the Maryland Department of Agriculture, and the University of Maryland to improve implementation of Maryland winter cover crop programs by development of remote sensing technology for landscape-scale monitoring of the effectiveness of cover crops to sequester nutrients and keep them from washing into the Bay. *This technology is being implemented on more than 6000 acres in the Choptank River watershed in Maryland.*

- Data on the ***nutrient composition of pork*** available in the national nutrient database was over ten years old. Furthermore, new practices in pork production have worked to develop pork into the "other white meat." New nutrient data on ten cuts of pork, sampled from grocery stores representative of the U.S. food supply and analyzed by methods developed by BARC ***scientists at the Nutrient Data Laboratory, show that there have been significant decreases in fat, saturated fat, and cholesterol.*** This will allow pork producers to label many of their meat cuts as 'lean" and "extra lean" in keeping with recent new regulations allowing such nutrient content claims on meats.

- BARC's national databases on food composition and food consumption form the ***scientific basis for the consumer nutrition education products of USDA's MyPyramid food guidance system***. Over 2 billion web hits have been recorded to the MyPyramid food guidance system since it became available on the web in 2005. The Beltsville Human Nutrition Research Center's (BHNRC) National Nutrient Database for Standard Reference is the underlying database that is used to generate BHNRC's Food and Nutrient Database for Dietary Studies and the Pyramid Servings Database, which form the basis of the information provided to consumers in MyPyramid and its personal Tracker, along with the soon-to-be-released Menu Planner. Food consumption data from BHNRC's continuing national food intake survey, What We Eat in America, supports these consumer-oriented dietary guidance products.

- The Nutrient Data Laboratory at BARC developed, through an agreement with *HealtheTech, Inc. (Golden, CO)*, innovative e-government products to bring the USDA National Nutrient Database directly to the American consumer. Easy access to quality nutrient data on thousands of foods and portion-specific units assists consumers with healthy food choices.

- *Choline* is a nutrient needed for normal cell function which assists in the metabolism of fat and cholesterol and prevents fat accumulation in the liver. *Betaine*, a derivative of choline, is important for its role in the donation of methyl groups used in the conversion of homocysteine to methionine. Intake data for the U.S. population has been lacking due to the absence of good data on the choline composition of foods. BARC scientists, in collaboration with scientists at the University of North Carolina at Chapel Hill, have established a *Special Interest Database, the USDA Database for the Choline Content of Common Foods* (USDA, 2004) on the choline and betaine content of foods. Nutrient values for total choline and betaine for approximately 500 foods as well as values for other specific choline metabolites are included. These data may be found on the NDL website: www.ars.usda.gov/nutrientdata/choline. Data from this project has been used in epidemiological studies to estimate population intakes of choline and has led to research implicating betaine intake to the etiology of neural tube defect.

- *Fluoride* consumption by the U.S. population, primarily in drinking water, has reduced the incidence of dental caries; however, excess consumption by children can lead to discolored and pitted teeth. In addition, too much fluoride can affect bone-forming cells and result in a condition known as "skeletal fluorosis." BARC scientists, along with scientists from the University of Iowa, the University of Minnesota, and the Institute of Dental and Craniofacial Research, NIH, have made a nationwide survey of fluoride in drinking water, popular beverages, and selected other foods.

The resulting data for about 500 food items have been released in the *USDA National Fluoride Database of Selected Beverages and Foods* which can be found on the following webpage: www.ars.usda.gov/nutrientdata/fluoride. Scant data were previously available on fluoride in the national food supply and therefore on the overall dietary fluoride consumption. This project provides a solid foundation for future studies geared toward finding out how various fluoride consumption levels affect dental caries, bone health, and other diseases.