From Molecules to Markets...
the Geneva Experiment Station Means Business for New York

New York State Agricultural Experiment Station

GENEVA, NY 2004 - 06

NEW YORK STATE AGRICULTURAL EXPERIMENT STATION
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Cornell University
College of
Agriculture and Life Sciences

Cornell University
College of Agriculture
and Life Sciences

FROM THE Director...

My new position as associate dean of the College of Agriculture and Life Sciences (CALS) has provided me with many insights into the functions and goals of the college and the university. In particular, I appreciate how the Experiment Station contributes in so many important ways to Cornell's Land Grant mission.

Geneva has a reputation as a place where New York's agriculture and food industries find cutting-edge technologies and answers to important questions. Whenever we host influential visitors, we are able to convey to them how Geneva's research and extension programs play vital roles in the economies of the state, the nation, and the world. It is more apparent to me than ever that the strong constituent relationships we've built over many years must be maintained, expanded, and strengthened.

Nationwide reductions in state and federal funding are changing the way academic institutions do business. At Geneva, we continue to identify new sources of support and improve efficiencies in our operations. It is imperative that our faculty seek new opportunities, compete for limited resources, and maintain a strong focus on our Land Grant Mission.

Many of the contributions covered in this review provide genuine cause for optimism. Faculty and staff at Geneva continue to be highly productive, and contribute advancements of major significance in basic and applied science that have major impacts on society.

In recognition of our accomplishments, we receive strong support from the CALS administration. Current faculty searches that will revitalize efforts in the Plant Pathology fruit extension program, in extension and research efforts at the Hudson Valley Lab, and in our enology and viticulture programs are evidence of this support.

Our stakeholder support remains very strong. I wish to thank the many members of the food and agriculture industries who wrote letters in support of our College when severe state budget cuts were forecasted, and who communicated the Experiment Station's positive impact to industry colleagues, and state and federal legislators.

Geneva has several highly productive partnerships that benefit us all. One of great importance is the USDA-ARS Plant Genetics Resources Unit where the number and quality of scientists have fostered synergistic relationships that strengthen vital research and outreach programs. This year's announcement that the USDA will build a national research center for grape genetics on the site of the Cornell Agriculture and Food Technology Park further elevates Cornell as a world leader in enology and viticulture.

This year's construction and opening of the Agriculture and Food Technology Park—also known as The Technology Farm—further strengthens the partnership among the Experiment Station, Cornell, surrounding academic institutions and businesses, and our community. Initial tenants have been identified. The vision of commercializing Cornell technologies and expanding economic development for New York is becoming a reality.

In closing, I want to thank all of you who have made my first year as director of the Experiment Station enjoyable and rewarding. I deeply appreciate the support from staff, faculty, and our stakeholder communities, and look forward to a bright future together.

Thomas J. Burr

Thomas J. Burr, Director
New York State
Agricultural Experiment Station
Geneva, NY

Healthy Plants, Healthy Planet, Healthy Food, Healthy People

ACCOMPLISHMENTS WITH IMPACT: 2004-2006

Developing and Selecting New Crop Varieties

Orange Healthy Cauliflower

More than 30 years of work by former plant breeder Michael Dickson resulted in the release of an orange variety of cauliflower that contains approximately 25 times more vitamin A than white cauliflower. Working with a mutant orange cauliflower found in Canada in 1970 and using conventional breeding techniques, Dickson released the improved germplasm to seed companies in 1989 for further development. By 2004, seed supplies were sufficient for distribution to home gardeners and commercial growers.

New York ranks third in cauliflower production in the U.S., with a crop that is valued at over $9 million.

New Plums and Cherries

In 2005, fruit breeders at Geneva released two new cherries and six new plums. The new stone fruits were patented and trademarked by the Cornell Research Foundation, sub-licensed to nurseries, and primarily intended for the processing market. BlackYork™ is a dark-fleshed, sweet cherry suited to humid climates, and especially valuable for use in yogurt. BlushingGold™ has light-colored flesh, is high-yielding, and ripens mid-season.

Two of the plums, NY6™ and NY9™, are best for processing as infant food, but can also be used in fresh markets. Suggested uses for the four most recent plum releases are: Blues Jam™ and Jam Session™ for jams, sauces and jellies; Rosy Gage™ for fresh marketing through farmers' markets due to excellent taste and aroma; and Geneva Mirabelle™ for jams, jellies, and brandy.

Fruit breeding and evaluation have been a major focus at the Geneva Experiment Station since its founding by the New York State Legislature in 1880. Researchers have introduced more than 245 varieties of apples, grapes, berries, and stone fruits. They select for such traits as yield, flavor, winter hardiness, insect and disease resistance, vigor, and quality.

Developing Value-Added Products and Processes

Improving Maple Cream

Food scientists at Geneva increased the shelf life and improved the consistency of maple cream, thereby making the product easier to store and adding value for maple producers and consumers. Previously, maple cream tended to mold and separate.

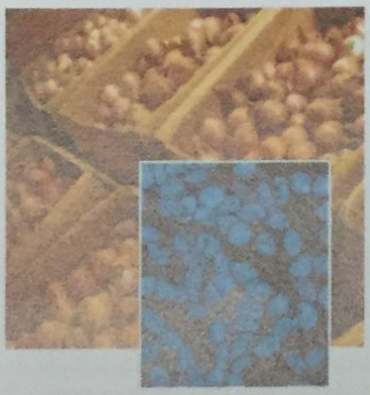
Researchers increased the shelf life of maple cream up to six months by adding potassium sorbate as a preservative. They addressed the issue of separation by controlling the level of invert sugar in the syrup through the use of invertase, a natural enzyme that inverts the sugar from sucrose to glucose and fructose. The processes could increase industry profits by 10 percent, and result in an additional $1.6 million in income per year for maple producers.

The state's maple industry ranks second in the U.S., and was valued at $7.19 million in 2004.

Apple Rootstocks that Beat the Cold

Two new Cornell-developed apple rootstocks showed strong resistance to unusually harsh winter conditions as evidenced by their survival in trials on cooperator farms after 2005's "perfect freeze" in New York's Champlain Valley. While nearly 25,000 apple trees were lost, the trees grown on Geneva® 30 and Geneva® 16 rootstocks exhibited better than 90 percent survivability. The rootstocks were originally developed for tolerance to fire blight, have the added bonus of winter hardiness, and should prove to be a boon to apple producers.

New York ranks second in the U.S. in apple production, with a crop valued at over $148 million.



Protecting Onions by Seed Coating

Through work at Geneva, onion seeds can be encased in a type of "film coating" adapted from the pharmaceutical and confectionery industries. The coating provides the means to accurately apply small amounts of plant protectant to the seed that controls insects and diseases. The end results are that growers apply less pesticide per acre, and that plant protectants are applied along with the seed rather than via bulky in-furrow treatments.

In 2004, New York ranked fifth in the U.S. in the value of the its onion crop, and fourth in acres planted to onions, with a crop valued at over $54 million.

Reducing Pesticide Use on Beans

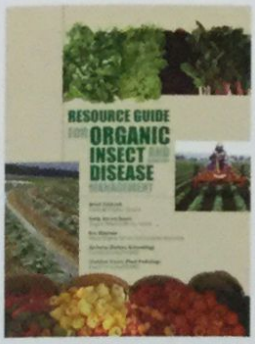
Snap bean growers now have a safe, effective, economical and easy-to-use alternative to organophosphate insecticides thanks to researchers from Geneva who discovered that only half an ounce of thiamethoxam is needed to control seedcorn maggot and potato leafhopper in one acre of snap beans. Replacing the organophosphates with thiamethoxam seed treatment results in a 96 to 98 percent reduction in the amount of insecticide needed.

In New York, in 2005, 100 percent of the processing snap bean acreage was treated with thiamethoxam seed treatment. Adoption of this seed treatment reduced the amount of insecticide used on snap beans in New York by as much as 23,000 pounds.

Improving Sweet Cherry Production

Researchers in horticultural sciences and food science and technology developed an integrated system for producing high-quality fresh-market type sweet cherries in New York. The result of more than 10 years of research, the system improves management practices for growers that increase yield, improve fruit quality, and thereby increase profitability.

Elements include cultivation practices like berming soil and tiling; copper sprays; dwarfing rootstocks; high-density tree planting; minimal pruning during the first four years; new varieties; improved spray technologies; rain covers and/or salt sprays to minimize fruit cracking; bird protection netting; and special modified-atmosphere packaging that extends the marketable life of sweet cherries



New Guide for Organic Farmers

The *Resource Guide for Organic Insect and Disease Management* was co-authored by Geneva research support specialist Brian Caldwell and Geneva professors Tony Shelton and Chris Smart, in cooperation with organic education specialists Emily Brown Rosen and Eric Sideman. The 169-page book, now in its second printing, provides detailed crop management practices for five of New York's most important vegetable groups: lettuce, sweet corn, brassicas (cabbage and related crops like broccoli, Brussels sprouts, cauliflower and Chinese cabbage), cucurbits (squash and its relatives), and solanaceae (tomatoes, potatoes, peppers and eggplants). Dozens of color photos help growers identify insect and disease problems. An on-line version, with links to printable PDF files, is available at www.nysaes.cornell.edu/pp/resourceguide/.

Organic producers comprise only two percent of the overall food production system, but the number of farmers and acres dedicated to organic farming has been steadily increasing over the last 10 years. Sales of organic food have increased approximately 20 percent annually.

Bracing for Swede Midge

A tiny fly called the swede midge has already wreaked havoc across Eastern Canada's cabbage and broccoli fields, and is now in New York. Although nearly undetectable to the naked eye, the swede midge poses a major threat to the Empire State's cabbage crop, valued at $87 million annually, and the state's $6 million annual crop of broccoli, Brussels sprouts, cauliflower, Chinese cabbage, and related crops. Agricultural scientists and extension educators at Cornell are working to keep the swede midge unsder control by evaluating chemical and biological strategies, publishing an identification guide, and educating crucifer growers in New York.

Managing New Threats to Turf

European crane flies can severely damage all types of turfgrass and forage grass species, and attack seedling nurseries and a wide range of vegetables and small fruits. The arrival of two species of European crane fly in 2004 is of major significance to the golf industry and other sectors of the turfgrass industry, according to Daniel Peck, a turfgrass entomologist who is testing chemical and biological pesticides to help manage this invasive species.

There are 3.4 million acres of turfgrass in the state, and the turfgrass industry contributes $5.1 billion annually to the state's economy.

A Warning System for Downy Mildew

The downy mildew pathogen attacks grapevines throughout the Eastern U.S. It both rots fruit and defoliates vines, causing reduced yield and predisposing vines to winter injury. The disease often seems unpredictable because it requires a precise sequence of weather conditions. Consequently, growers sometimes apply expensive fungicides when they are not needed, or worse, do not use fungicides when they are truly needed and suffer crop losses as a result. Plant pathologists at Geneva set out to predict the incidence of this destructive disease and were successful in developing a simple weather-driven forecasting system called DMCast, which is now available on the web at www.nysipm.cornell.edu/news for anyone who needs to determine the future threat of downy mildew.

Partnering with Local Schools

About a dozen scientists from the Experiment Station held a science camp for local third-graders. The project was spearheaded by plant pathologist Chris Smart and involved faculty and staff. The sessions were filled with hands-on activities focused on horticulture and food science, where students grew fruits and vegetables in greenhouses at the Experiment Station and gardens at North Street School.

In another local partnership, graduate student Shannon Olsson supervised and advised 53 Geneva High School students in the research, design and implementation of a project on human body odors that provided the students with an introduction to the scientific process. Their research was made possible though the Cornell Science Inquiry Partnerships Program (CSIP) and the National Science Foundation's Graduate Teaching Fellows in K-12 Education Program. Intended to develop inquiry learning and update science and engineering content, the programs partner graduate students with high school teachers to enhance learning opportunities for secondary school students. This research will be published in an upcoming issue of the *Journal of Chemical Ecology* with 53 high school authors.

Schools for Fruit Growers

In July 2004, over 300 attendees at the Centennial Fruit Field Days and Equipment Show in Geneva took advantage of more than 50 presentations by Cornell researchers on the latest developments in fruit production, including innovative work in cropland management, high-density orchard systems, new rootstocks, new methods of disease and insect control, enhancing fruit quality, variety development, genetic preservation, weed control, sprayer technology, and food safety. Held every four years, the event was organized by the Cornell Fruit Program Work Team.

In the spring of 2005, 90 attendees participated in the Robert L. Andersen Stone Fruit Symposium to honor the achievements of the retiring stone fruit breeder. Prominent researchers from all over the U.S. and Canada joined growers, marketers, and staff and faculty from Cornell and Cornell Cooperative Extension to share information about developments in pollination biology, variety development, rootstocks, genetics, breeding, and training systems.

Fostering Economic Growth

Enhancing Rural Development

Sites of 261 start-up and established NYS food companies, 2003-2004

In 2004, the Northeast Center for Food Entrepreneurship (NECFE) received a U.S. Department of Agriculture Secretary's Honor Award in the category of "Supporting Increased Economic Opportunities and Improved Quality of Life in Rural Areas." Olga Padilla-Zakour, director of NECFE, accepted the award and was cited for "development of a highly productive center which provides comprehensive assistance to beginning and established food entrepreneurs that resulted in sustainable economic development of rural communities." NECFE offers technical and business advice to small-scale and start-up food processing businesses, providing information on marketing, product design, safety, and federal and state regulations. After five years of operation, NECFE has helped 600 entrepreneurs commercialize 2,200 food products, creating 806 new full-time jobs and helping support 7,000 existing jobs.

Assuring High Quality Foods and Beverages

Adding Value to the Wine Industry

Enology and viticulture programs at Geneva help grow New York's wine and grape industry by providing research-based technology and education. Over the last 30 years, enologists and viticulturists have helped increase the number of New York's wineries from nine to 214, with eight viticultural regions now established across the state. Ongoing studies at Geneva link plant physiology with flavor chemistry and grape genomics; improve knowledge of grape cultivation and wine grape production; manage insects and diseases; breed varieties better suited to New York; study the flavor modifications by micro-organisms on grapes during wine fermentation and wine aging; conduct wine analysis and stability testing to avoid defects, and explore the flavor envelope of new and established wine grape varieties to help develop distinct New York wines of high quality; and help maintain open viewscapes with vineyards that enhance the natural beauty of New York's grape growing regions.

New York wineries and vineyards positively impact rural economic development, and contribute over $3.4 billion in gross sales to the state's economy.

Applying Biotechnology

Unraveling the Sexual Chemistry of the German Cockroach

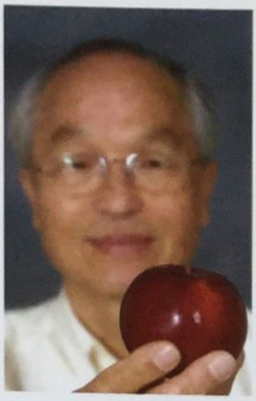
The German cockroach plagues places where food is stored, prepared or served—in homes, apartments, restaurants, supermarkets, and hospitals around the world. Homeland security for the pesky cockroach is a thing of the past now that a team of entomologists from Cornell, the State University of New York's College of Environmental Science and Forestry, and North Carolina State University have succeeded in isolating, characterizing and synthesizing the sex pheromone of the female German cockroach.

This breakthrough has resulted in an important new tool for the control and management of this pest. Cornell has filed a patent, and several companies are evaluating the pheromone for commercial use.

Phosphatase and Brix in Apples

Researchers found a positive relationship between the activity of acid phosphatase and the Brix/acid ratio in apples that could significantly enhance the economic and health benefits of apples for growers, processors, and consumers. High-acid phosphatase cultivars such as Empire and Idared have a high Brix/acid ratio. Conversely, low-acid phosphatase cultivars like Zapta, Cap of Liberty and Edward VII, show a low Brix/acid ratio. The Brix/acid ratio is commonly used as a measure of fruit maturity and palatability.

The results of the research strongly indicate that acid phosphatase could serve as a valuable genetic marker for apple breeders and molecular biologists to develop new cultivars with a desirable Brix/acid ratio for fresh market or processing purposes.



An Apple a Day Keeps the Doctor Away

A group of chemicals found in apples could protect the brain from the type of damage that triggers such diseases as Alzheimer's and Parkinson's, according to a study published by food scientists Chang Y. "Cy" Lee and Ho Jin Heo. The study showed that the chemical quercetin, a phytonutrient that provides the fruit's anti-oxidant and anti-cancer benefits, also appears to play a role in reducing the risk of neurodegenerative disorders. Lee and Heo found that the higher the concentration of apple phenolic extract applied to the rat neuronal cells, the greater the nerve cell protection against oxidative stress.

This study adds to the growing body of scientific evidence that a diet rich in certain fruits and vegetables can protect the body against degenerative diseases.

Identifying Peanut Allergens

Food scientists at Geneva have developed a competitive lateral flow immunoassay capable of detecting the major peanut allergen Ara h1 quickly, economically, and on-site. This simple and sensitive method works within 30 minutes.

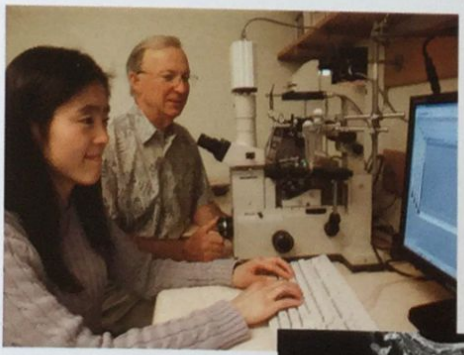
One of the important requirements for detecting peanut contamination and developing a sensitive assay is to increase the extraction efficiency of peanut allergens from food. Innovative Biotechnologies International, Inc., a New York State company, has licensed the technology from the Cornell Research Foundation and plans to commercialize this application.

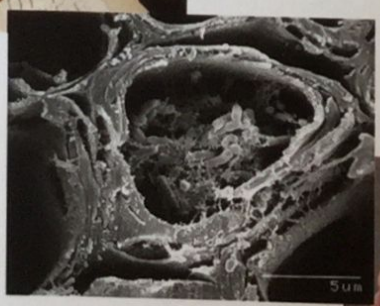
About 1.1 percent of all Americans, or three million people, are allergic to peanuts, tree nuts, or both, and the prevalence of peanut allergies in the U.S. is increasing.

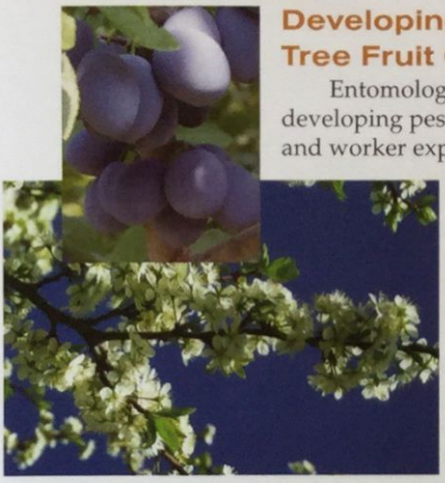
Bacteria that Swim Upstream

Using nanofabricated microfluidic devices, plant pathologists at Geneva discovered that a bacterium that causes economically important plant diseases, including Pierce's disease in grapes, migrates upstream against the flow of xylem sap using hair-like pili that mediate twitching movements, and pull the bacteria along. How the bacteria move in the plant's vascular system—against the direction of sap flow—has long been a puzzle and an important consideration when explaining the spread of the bacteria within the plant.

Ultimately, growers will benefit from these discoveries which may lead to better disease control.







Developing Reduced-Risk Pest Programs for Tree Fruit Growers

Entomologists in Geneva and the Hudson Valley are developing pest management systems to greatly reduce residues and worker exposure to organophosphate, carbamate, and pyrethroid insecticides. By evaluating tactics that reduce risk but remain effective, sustainable, economically viable, and compatible with biological control, it is possible to reduce or eliminate insecticides that are potentially harmful to the environment. The program also increases opportunities for biological control; reduces farmworker exposure to highly toxic insecticides; and supports an agricultural sector that contributes to the green-space diversity of the landscape.

Strengthening Food Security and the Regional Food Chain

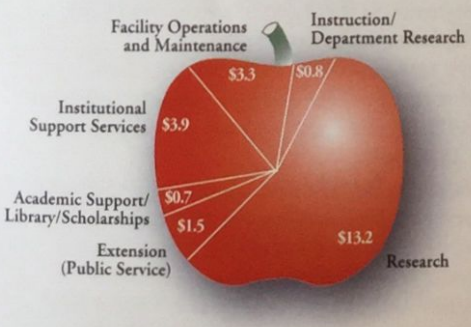
Scientists from different disciplines and organizations along the food chain held a summit to discuss challenges that face agriculture and food industries in upstate New York. The summit encouraged participants to discuss how multi-disciplinary collaborations "from seed to farm to fork" might ensure a fresher, safer, and more nutritious food supply by monitoring the food chain from seed production to food packaging.

Topics included food production, vertically integrated production and marketing, fruit and vegetable processing, global wine enterprises, livestock production, food safety and packaging, and meeting the health and safety needs of retail food customers.

Co-sponsors of the event were Ontario County, the Experiment Station, the Cornell Agriculture and Food Technology Park, and the Infotonics Technology Center.

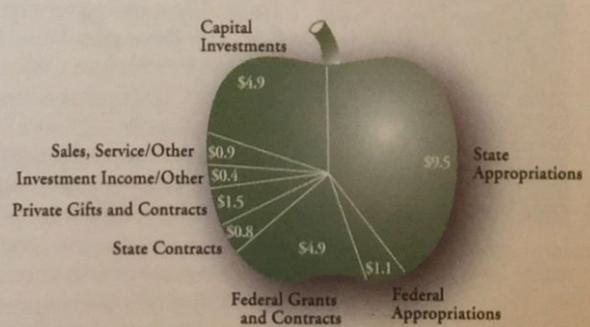
Fiscal Facts About Geneva: July 1, 2004 - June 31, 2005

Expenditures for FY04/05 in Millions



Total Expenditures: $23.46

Revenue for FY04/05 in Millions



Total Revenue: $24

The Technology Farm Opens

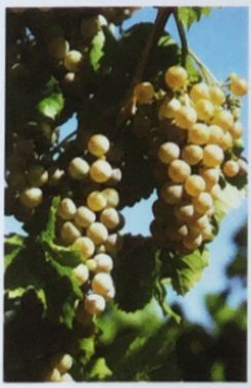
The Cornell Agriculture and Food Technology Park completed construction of its 20,000-square-foot "flexible technology building" and welcomed its first tenants in November 2005. Known as the "Technology Farm," the park is designed to foster the creation of innovative and breakthrough technologies on a 72-acre campus adjacent to the Experiment Station. Tenants include entrepreneurs and established companies interested in developing the next generation of food, agriculture, and bio-based products. They can collaborate with Cornell University faculty from the College of Agriculture and Life Sciences in Ithaca and Geneva and easily link to cutting-edge research in beverage technology, crop and turf protection, plant germplasm technology, wine and viticulture, seed technology, transgenic technology, food and food safety, horticultural sciences, and precision agriculture.

Capitalizing on a unique partnership that was developed over the last 10 years, developers have been able to raise more than $8 million from federal, state and local governments to establish The Technology Farm. At full build-out, 375,000-square-feet of space will be available for research, development and light production.

Linking Industry, Government and Academia

A February 2005 colloquium entitled "Economic Development and Emerging Opportunities" brought together 125 faculty, legislators, industry leaders, and economic developers from different regions of New York to explore how research generated by Cornell University positions the region to be at the forefront of agriculture and bio-related economic development.

"Partnerships between researchers and universities are driving the 21st century economy and producing the next generation of products and services," said Senator Michael Nozzolio, who hosted the colloquium with Cornell's College of Agriculture and Life Sciences, the Experiment Station, and the Cornell Agriculture and Food Technology Park.



Adding to Geneva's Critical Core Competency in Grapes

The Agricultural Research Service, or ARS, the U.S. Department of Agriculture's chief scientific research agency, will establish a new Grape Genetics Research Center at the Technology Farm. The new center will expand on the agency's existing Plant Genetics Resources Unit, which is currently housed on the Experiment Station's 900-acre campus. With funding obtained through Congressional appropriations, the agency plans to begin construction in 2007 of a 59,000-square-foot research facility that will employ approximately 20 people.

Researchers at the Experiment Station and the USDA-ARS already collaborate on the preservation and use of plant genetic resources in brassicas, and cold-hardy apples and grapes. The development of this new center will further enhance Geneva's reputation as a leading research center for enology and viticulture in the U.S., and provide further support for New York's $6 billion wine industry.

Our Vision

To be a world leader in the creation and application of knowledge and innovative technologies in agriculture and food science.

Our Mission

As an integral part of the College of Agriculture and Life Sciences at Cornell University, the New York State Agricultural Experiment Station will advance a sustainable agriculture and food system through innovative research, education, and extension programs that improve human health, protect the environment, and support economic development to address state and global needs.

Our Values

The New York State Agricultural Experiment Station is committed to a work environment that fosters and honors:

- **excellence**
- **achievement**
- **innovation**
- **agility**
- **collaboration**

Vital Statistics

- **Established in 1880**
- **Four academic units:** Entomology, Food Science & Technology, Horticultural Sciences, Plant Pathology
- **Seven support units:** Director's Office, Administrative Service Center, Buildings & Properties, Communications Services, Computer Center, Field Research Unit, Library
- **Outlying laboratories:** Fredonia, NY, and Highland, NY
- **Personnel**
  - 275 employees (135 on state funds)
  - 54 professors and program leaders
  - 49 other Ph.D-level scientists
  - 39 graduate students
  - 34 visiting scientists in residence
- **914-acre campus, including:**
  - 864 acres of farm land for research
  - 1 acre of greenhouse space
  - 623 square feet of buildings
- **Annual budget: $25M**
  ($9.4M funded through SUNY)

Partnerships with Industry

- Geneva technology can be licensed from the Cornell Research Foundation for commercial development.
- Patent Activity: Jan. 1, '04 - Dec. 31,'05
  - 4 Foreign patents filed
  - 6 Foreign patents issued
  - 17 U.S. patents filed
  - 11 U.S. patents issued

2004-2005

New hires

Daniel J. Fessenden, Executive Director of the Cornell Agriculture and Food Technology Park. (2004)

Dr. Marc Fuchs, Plant Pathology, virus diseases of vegetable and fruit crops. (2004)

Dr. Amanda J. Garris, Plant Genetic Resources Unit, grape functional genomics. (2004)

Faculty awards and appointments

Dr. Anthony Shelton, Entomology, Recognition Award of the Entomological Society of America. (2005)

Dr. Harvey Reissig, Entomology, Director of the Pesticide Management Education Program. (2005)

Dr. Harvey C. Hoch, Chair, Department of Plant Pathology. (2005)

Dr. Randy Worobo, Food Science and Technology, Director of Undergraduate Education at the NYS Agricultural Experiment Station. (2005)

Dr. Susan Brown, Horticultural Sciences, Jackson Dawson Memorial Medal from the Massachusetts Horticultural Society. (2005)

Dr. Robert L. Andersen, Horticultural Sciences, Cherry Industry Distinguished Service Award, and Lifetime Achievement Award. (2005)

Dr. David Rosenberger, Plant Pathology, Award of Merit, American Phytopathological Society (Northeast Division). 2005

Dr. Arthur M. Agnello, Entomology, Award for Excellence in Integrated Pest Management. (2005)

Dr. Robert C. Seem, Plant Pathology, Chief Scientific Officer - Cornell Agriculture and Food Technology Park (2005); Fellow of the American Phytopathological Association. (2004)

Dr. Thomas Burr, Plant Pathology, Associate Dean of CALS, and Director of the NYS Agricultural Experiment Station. (2005)

Dr. Jan Nyrop, Chair, Department of Entomology, Ithaca. (2004)

Dr. Karl J. Siebert and Penelope Y. Lynn, Food Science & Technology, Eric Kneen Memorial Award. (2004)

Dr. Alan Taylor, Chair, Department of Horticultural Sciences, Geneva. (2004)

Ellen Chirco, Director of the NYS Seed Testing Laboratory, named President of the Association of Official Seed Analysts for the second time. (2004)

Dr. John S. Roberts, Food Science and Technology, International Young Food Engineer Award. (2004)

Heritage Raspberry, released by Geneva in 1969, Outstanding Fruit Cultivar Award. (2004)

In Memoriam

Dr. Edward H. Glass, Professor Emeritus of Entomology, and department chairman from 1969 to 1982, was internationally recognized for his work on the biology and control of fruit pests, and was instrumental in developing the use of sex pheromones for orchard insect monitoring and control. (2005)

Gifts

Mary Lienk bequeathed more than $400,000 in memory of her husband, entomologist **Dr. Sigfried S. Lienk,** to the Paul J. Chapman Graduate Fellowship Fund in the Department of Entomology. (2004)

The first award was made from an endowment established in memory of **Dr. Robert Gilmer** to support the research of a graduate student in the Department of Plant Pathology, where he served as professor and chairman. (2004)

For More Information

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Produced by Communications Services, NYSAES, Geneva, NY 5/06