New York State
Agricultural Experiment Station

Healthy Plants • Healthy Planet

Healthy Food • Healthy People

GENEVA, NY

The Year in Review 2001

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

CORNELL

FROM THE DIRECTOR . . .

The terrorists' attack on the United States on September 11 was the pivotal event of 2001 and has led to many changes in our thinking about physical security and economic well-being. Increased precautions have been taken to prevent future attacks by those people who would do us harm. And we continue to struggle to more clearly understand why the United States elicits such hatred from people in parts of the world where few of us have traveled, and what we can do to create greater understanding and tolerance among peoples of different cultures. And you might ask why I focus on terrorism and global understanding in an annual report about the New York State Agricultural Experiment Station in Geneva, NY?

The answer is because the Station is an integral part of Cornell University, an institution with a global reach in many fields, particularly in science and agriculture.

For many years, students have come from all over the world to study at Cornell. They will continue to do so in increasing numbers in the future. In recent years, many foreign graduate students have conducted research for their theses under the tutelage of Cornell faculty on the Geneva campus. Visiting scientists and post-doctoral candidates from around the world have come to the Station on study leaves; most paid for by grants from their governments or international organizations. These are some of the best and brightest young people these countries have to offer, people who will play a critical role in the country's intellectual and scientific future.

We have come to know these students and scientists as dedicated and able professionals. And we are grateful we have had the opportunity to experience the goodness of these people and share in a cross-cultural exchange of our own good intentions. Our experience reminds us not to generalize about people from other parts of the world on the basis of the few who seek to destroy our way of life.

In addition to promoting understanding among peoples of the world who visit or work at the Experiment Station, and to be good ambassadors for our country when we travel to other parts of the world, what should be the Station's role after September 11?

We need to stay focused on research and extension efforts to help strengthen the agricultural and food sector of the New York State economy. We must continue to develop technologies to improve farming practices that result in higher quality raw products while reducing production costs, and we need to ensure that production practices do not harm the environment. We need to do our part to attract agriculture, food, and biotechnology businesses to New York that contribute to the economic viability of urban and rural communities. And, while continuing to focus on the Station's mission in spite of September 11, we will redouble our efforts conducting research that results in the development of improved methods to detect human and plant pathogens and chemical toxicants in food and water—research that is increasingly relevant to people's security in a troubled world.

Activities and accomplishments reported in this "2001 Year in Review" provide strong evidence of the Station's continuing contributions in agricultural research that benefit the economy locally, state-wide, regionally, and nationally. In the long run, Geneva helps provide higher standards of nutrition and health for people on a global level because of our scientists' many interactions within the international scientific community. We believe these are important ways we can contribute to a better and more stable world.

James E. Hunter

James E. Hunter, Director
New York State
Agricultural Experiment Station

The New York State Agricultural Experiment Station (center), is located in Geneva, NY, near the 35-mile-long Seneca Lake (top), within 50 miles of Cornell University's Ithaca campus.

ACCOMPLISHMENTS WITH IMPACT: 2001

GROWING CROPS COMPETITIVELY

Forecasting and Controlling Apple Scab

Corrected flaws with the preexisting system used to forecast apple scab infection and determined at what stage apple trees are most susceptible to infection, allowing growers to precisely time sprays to when they are most needed to combat the disease most effectively and efficiently. Apples are New York's largest fruit crop— 55,000 acres of orchards produce nearly one billion pounds of fruit annually — and apple scab is the most destructive disease of apples.

Ag Engineering on the Move

Cornell's agricultural spray program was shifted from Ithaca to GENEVA where there are state-of-the-art spray facilities. The move allows closer interaction with fruit and vegetable growers. In 12 field trials, Andrew Landers evaluated a variety of sprayers and nozzles for reducing drift and increasing spray deposition. These technologies were demonstrated to grape, apple, vegetable and turfgrass growers in 35 field meetings throughout New York State and around the country.

Agricultural engineer Andrew Landers explains how to reduce spray drift and increase deposition at a field meeting for fruit growers.

Using Less Fertilizer

Established that when a particular strain of the fungus, *Trichoderma harzianum*, is present in the soil, it drastically improves the uptake of nitrogen and reduces the amount of nitrogen fertilizer required to grow corn. Scientists at GENEVA developed the strain from *Trichoderma* that is commonly found in soil. If it were applied to the over 33,000 acres of corn harvested in New York in 2001, the fungal strain has the potential to cut nitrogen fertilizer use in New York by over one million pounds annually.

GROWING HEALTHY CROPS & SUSTAINING THE ENVIRONMENT

Fungus-controlling Mites

Found good control of powdery mildew, a major disease of grapes, using beneficial mites as biological control agents. A tydeid mite, *Orthotydeus lambi*, provided 50% to 80% control of the disease without the use of any fungicide. The mite was also shown to control powdery mildew on cucumbers and roses in commercial greenhouses. Biological controls use natural predators to help control pests and diseases, thereby reducing the amount of chemical pesticides applied—a primary goal of the Integrated Pest Management (IPM) program.

Researchers at GENEVA discovered that this beneficial tydeid mite helps control grape powdery mildew by feeding on the fungi that causes it.

Pheromones in Peaches

Studied mating disruption of the Oriental fruit moth in peaches. Pheromone disruption appears to have the potential for providing acceptable control of this pest within peach orchards. Border sprays of insecticides may be needed in some cases to prevent moths migrating into orchards from non-disrupted areas.

Reducing Fungicide Sprays

Identified the critical susceptible periods for infection of grapes by fungi that cause black rot, powdery mildew, downy mildew and Botrytis rot. Grape growers in the Northeast are plagued by fungal diseases that do much less damage to the grape crop in drier climates. Knowing precisely when the plant is most susceptible to infection allows growers to spray only when it is most important, eliminating several unnecessary sprays that are a part of traditional spray programs without sacrificing any disease control. This information was distributed to growers to help them reconcile the need to produce high-quality, disease-free crops in the face of economic pressure to reduce costs and societal demands to restrict fungicide use.

APPLYING BIOTECHNOLOGY

Crown Gall Resistant Grapes

Transformed grapevines were developed that show reduced susceptibility to the bacterial disease, crown gall. Because the bacterium survives systemically in vines, chemical sprays cannot control the disease. Using modern biotechnology procedures, a partial gene from the pathogen, *Agrobacterium tumefaciens*, was inserted into grape, thereby conferring resistance. Genetic engineering by this and other biotechnology approaches shows promise for controlling crown gall in grapes.

Genetically transforming grapes to reduce their susceptibility to crown gall is a promising technology to combat this bacterial disease.

Safer Synthetic Transgenes

Designed synthetic transgenes for conveying resistance to virus diseases. Traditionally, genes from a virus are transferred to the plant to impart resistance, but those genes could potentially recombine with a different virus, creating a new pathogen. Computer generated sequences of artificial viral proteins have been created that are similar enough to real viral proteins to impart resistance, but which greatly reduce the risk of recombination. Short segments of synthetic DNA can be made that convey resistance to multiple viruses. Transgenic plants have been developed with resistance to groundnut ringspot virus and tomato spotted wilt virus using this method.

DEVELOPING AND SELECTING NEW VARIETIES

Better Honeycrisp Apples

Established a planting consisting of 50 strains of the increasingly popular new apple cultivar, 'Honeycrisp', for evaluation of horticultural and fruit quality, and characteristics such as appearance, color, taste, texture and storage potential. Various methods were tested to thin the 'Honeycrisp' trees, control bitter pit, control fruit maturity and improve color. While other apple varieties are becoming unprofitable, the wholesale price of 'Honeycrisp' continues to rise as consumer demand increases, making it an extremely important new variety.

Disease Resistant Wine Grapes

Developed lines of Chardonnay and Merlot grapes that produce an anti-fungal enzyme. They are now being field-tested for disease resistance. More than 100 additional lines of Chardonnay producing a small anti-microbial protein have also been developed. These lines are currently being tested for disease resistance with greenhouse-grown plants.

Improvement of *Brassica* Vegetables

Several pests and diseases affect cabbage and *Brassica* vegetable production in New York, including: black rot, white mold, *Alternaria* and thrips. The most effective long-term solution to these problems is incorporation of host plant resistance. During 2001, several advances were made in the breeding of cabbage for pest resistance through the support provided by the New York State Cabbage Research and Development Fund. These advances included selections of pest-resistant accessions and development of inter-specific hybrids between cabbages and a related mustard species for introgression of black rot resistance. Over 30,000 plants were screened during 2001, from which selections were made for pest resistance, quality, and increased value for the cabbage industry.

Over 30,000 cabbage plants were screened at GENEVA to better characterize the genetics of black rot resistance.

ENSURING A SAFER FOOD SUPPLY

Longer Holding Times for Manure Fertilizers

Microbiologists at GENEVA determined that the proposed USDA/FDA guidelines for the use of untreated manure as a fertilizer were inadequate. The practice of using untreated manure on fruits and vegetables as a souce of nitrogen (a practice common among organic growers) allows for the introduction of pathogens that can potentially cause food-borne illnesses in consumers. Proposed USDA/FDA guidelines suggested 60 days as the adequate time for total destruction of fecal pathogens that may be present in untreated manure. However, the survival rates for typical fecal pathogens such as *E. coli* O157:H7 and *Salmonella* spp had not been established. Food scientists at GENEVA used nonselective green fluorescent bioengineered markers in pathogens to track the survival of *E. coli* O157:H7 and *Salmonella* spp. in manure and manure amended soil. The results of this study showed the survival of pathogens in manure-amended soil past 100 days post inoculation, and suggested the USDA/FDA recommended hold time be increased to ensure the safety of fruit and vegetable crops grown in manure amended soil. This work was funded by USDA-CSREES.

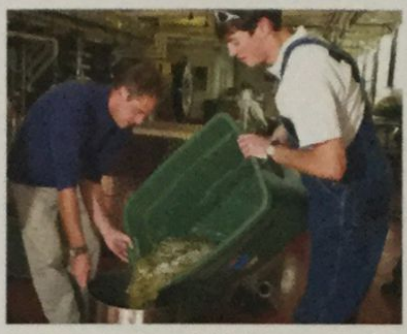
Assuring High Quality Foods

Stopping Post-Harvest Rot

Determined the main source of inoculum of the fungus, *Penicillium expansum*, responsible for causing rot in stored apples. Because the bacterium survives systemically in vines, chemical sprays cannot control the disease. Researchers found that sanitizing the reusable wooden or plastic bins between seasons could significantly reduce post-harvest losses. The fungus has become resistant to the commercial fungicides used to treat it and post-harvest losses are increasing because no other method for controlling the fungi on the apples is available.

A Successful Gala

Raised $20,000 for the new Vinification and Brewing (V&B) Technology Lab at the Fourth Annual Wine Country Dinner & Gala Auction. The V&B Lab opened in March of 2000. Funds generated at the affair were added to the $535,000 already raised through government funding and private donations. Researchers, winemakers, brewers, and industry representatives who will benefit from the facility attended the dinner along with community leaders, politicians, wine connoisseurs, and Cornell alumni. The 2,000-sq. ft. laboratory is being used to carry out research and extension work to help improve the quality of wine and other fermented beverages in New York.



In 2001, the Cornell Vinification & Brewing Technology Lab completed its first full year of operation. Private and public monies fund its operation.

Fostering Economic Development

Tested a Record Number of Wine Samples

The Cornell Wine Analysis Laboratory at GENEVA performed 4,753 laboratory analysis on 533 wine samples from 51 clients. 2001 was the busiest year for laboratory, with 48 commercial wineries, two hard cider producers and one home winemaker taking advantage of the laboratory's diagnostic and consulting services. The laboratory recommended measures to improve the quality of several wines tested, and helped wineries avoid sizable losses.

More High-Tech Jobs in the Finger Lakes Region

Successfully completed three years of negotiations in the New York State Assembly for land needed to begin construction of Cornell's Agriculture and Food Technology Park at GENEVA. The State Assembly, the State Senate, and Governor George Pataki approved legislation authorizing the swap of 74 acres of State University of New York land to be used for the park in exchange for Cornell-owned land in the area. The Ag & Food Tech Park's mission is to foster the expansion of agriculture, food science, and biotechnology research while promoting economic growth. The new park will enable start-up and established companies to carry out cutting-edge research, foster opportunities for technology from existing Cornell/GENEVA and Cornell/Ithaca research to be transferred into the commercial sector, and complement existing research and extension programs.

Reaching Out to Educate

What's In Store

Worked with Wegman's, a mega-supermarket chain with stores in NY, PA, and NJ, to develop a consumer-friendly flyer about genetically engineered foods. "Genetically Engineered Foods 2001: A Consumer Guide to What's in Store," was distributed in information racks in Wegman's produce aisles in the tri-state area. The pamphlet provided information about what genetically engineered foods and ingredients are available and why these products are produced, if genetically engineered foods are safe to

This new pamphlet was produced in cooperation with Wegman's to help educate consumers about genetically engineered foods.

Governor George Pataki met with Bill Foster, CEO of the local company, BioWorks, Inc., to discuss products for improved crop production. The technology was developed by professors at GENEVA and transferred to the private sector. The company serves as a model for future Cornell Ag & Food Tech Park tenants.

eat, and other issues. The flyer can be viewed on Cornell's ag biotech web site at http://www.nysaes.cornell.edu/agbiotech along with other publications from Cornell's College of Agriculture and Life Sciences that aim to inform the public about genetic engineering.

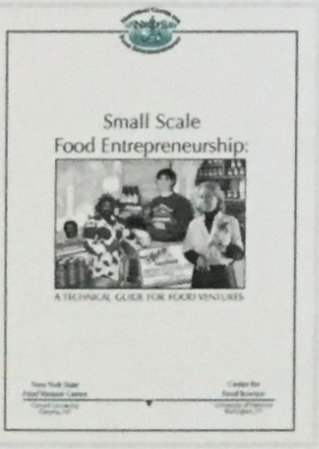
"Harvest of Fear"
Contributed extensively to the PBS NOVA/Frontline special report, "Harvest of Fear." Station scientists appeared on the television special to discuss their work with genetically modified organisms. Researchers spoke about developing the technology to make papaya plants resistant to the papaya ringspot virus which devastated the papaya industry in Hawaii from 1993 to 1995, and about the controversy regarding the effect of Bt corn on Monarch butterflies.

Multi-state IPM Project on Cucurbits
Initiated a three-year $500,000 cooperative project involving New York, Ohio, and Massachusetts to educate farmers, extension specialists, extension agents, and agribusiness people about the need to adopt sustainable integrated pest management (IPM) techniques for production of cucumbers, melons, pumpkins and squash. The project is aimed at agricultural producers whose current pest management practices make use of pesticides whose labels are threatened under the Food Quality Protection Act. It is led by New York's IPM Program.

Developing Value-added Products and Processes

Hands-on Food Manufacturing
"Good Manufacturing Practices for the Production of Shelf-Stable Acid, Acidified (Pickled) and Dehydrated Foods," was the first workshop in a series hosted by the Northeast Center for Food Entrepreneurship (NECFE) for food manufacturers. The series provides current and future small-scale food processors with the basic elements needed to understand the main processing steps, critical control points, and record-keeping involved in the safe manufacture of specialty food products for the market place. Technical information and practical demonstrations of the production of BBQ sauce, pickled vegetables, and dried fruit were the primary focus.

Selecting world-class wine and table grapes are goals of GENEVA horticultural scientists like Bruce Reisch.

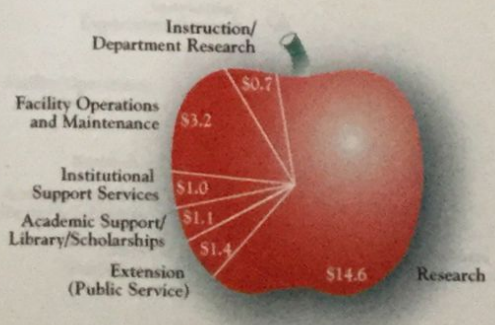


This 108-page manual for small-scale food processors, published by the Northeast Center for Food Entrepreneurship, went into its second printing in 2001.

Pinot Noir in New York
Importing and producing superior Pinot Noir clones is finally starting to pay off in the Finger Lakes Region. Pinot Noir is a particularly difficult variety of grape to grow anywhere, but scientists at GENEVA have identified Pinot Noir clones that will tolerate Upstate New York winters and produce superior wines. This work supports the goal of the newly formed Finger Lakes Pinot Noir Alliance, an association of 19 wineries and growers that promotes the growth of superior clones and the development of world-class Pinot Noir in New York.

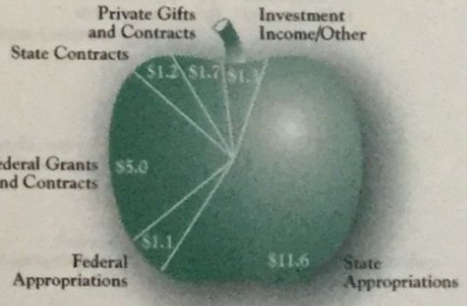
Fiscal Facts about GENEVA: July 1, 2000-June 30, 2001

Expenditures for FY00/01 in Millions



Total Expenditures: $22.0

Revenue for FY00/01 in Millions



Total Revenue: $21.9

Our Vision

To advance a sustainable plant agriculture and food system through state-of-the-art research and extension programs that address local and worldwide needs.

Our Mission

GENEVA supports New York's agricultural and food industries with research, extension and education programs. We:

- Use the best-suited scientific tools and systems to solve both fundamental and applied scientific questions pertaining to plant agriculture and food science;
- Improve competitiveness and profitability of growers and processors of fruit and vegetable crops, turf, and other expanding horticultural industries;
- Develop biologically and environmentally sound practices to produce, protect, and process horticultural crops and commodities;
- Develop and implement technologies to ensure wholesome foods;
- Serve the diverse clientele of the state and support emerging opportunities to enhance and expand plant-based agriculture and food systems;
- Help create, attract, and retain agricultural, food, and biotechnology enterprises within New York.

Vital Statistics

- Established in 1880
- Four academic units; five support units
- Outlying labs in Fredonia and Highland
- 303 employees (186 on state funds):
  50 professors and program leaders
  35 other Ph.D. level scientists
- 28 graduate students
- 28 visiting scientists in residence
- 900-acre campus, including:
  850 acres of farm land for research
  1 acre of greenhouse space
- 623,000 square feet of buildings
- Annual budget of $21.9M
  ($11.6M funded through SUNY)

Partnerships with Industry

GENEVA technology can be licensed from the Cornell Research Foundation for commercial development.

Patent Activity: Jan. 1 - Dec. 31, '01
2 Foreign patents filed
2 Foreign patents issued
16 US patents filed
8 US patents issued

New Hires

Dr. Ping Wang, assistant professor of entomology, conducts research on the genetics and biochemistry of insects, using genomics and bioinformatics to develop new products to control insects.

Marc Smith, assistant director, provides leadership for a wide range of activities essential to the smooth and efficient functioning of the Station, and acts as liaison with governmental agencies, agricultural producers and organizations throughout the state.

Dr. Brian Nault, assistant professor of entomology, works to understand insect pest activities within vegetable cropping systems in order to determine how pests can best be managed.

In Memoriam

Dr. Michael G. Villani, professor of entomology, was an expert on the ecology of soil-inhabiting insects, a noted turfgrass specialist, and co-author of the "bible" of the turfgrass industry.

Dr. Don F. Splittstoesser, professor emeritus of food science and technology and an international authority on food microbiology, was an expert on bacteria that cause food-borne diseases of humans, and microorganisms that spoil foods.

Dr. George A. Schaefers, professor emeritus of entomology, contributed heavily to the literature dealing with insects that attack small fruits in New York and the Northeastern United States.

Awards

Dr. Michael Villani, entomology, Outstanding Service Award from the Turfgrass Council of North Carolina.

Dr. Alan Lakso, horticultural sciences, fellow of the American Society for Horticultural Science.

Dr. Wendell Roelofs, entomology, the Kenneth A. Spencer Award for Outstanding Achievement in Food & Agricultural Chemistry.

Dr. Steve Reiners, horticultural sciences, Outstanding Cross Commodity Publication, American Society of Horticultural Science.

NE-183 (the multi-state project to evaluate apples, led in NY by Geneva faculty), Secretary of the U.S.D.A. Department of Agriculture Honor Award.

NYS Agricultural Experiment Station, Geneva Area Chamber of Commerce Business of the Year.

For More Information

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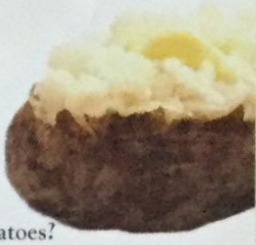


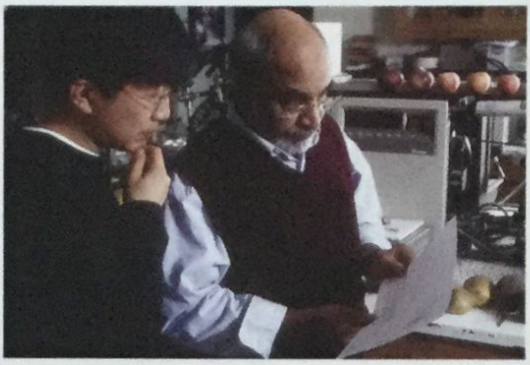
Discovering Fundamental Knowledge for Future Applications

Directing the National Research Agenda
GENEVA scientists managed six grant panels funded by the United States Department of Agriculture, including one for "Risk Assessment," one for "Biologically Based Pest Management," and one for the "Initiative for Future Agriculture and Food Systems." These panels are charged with assessing research projects and distributing millions of dollars among hundreds of applicants. Grant panels are the primary means by which federal funding is allocated for research across the country. The fact that GENEVA scientists led six of the panels means the researchers play a key role in influencing the direction of research throughout the country, and are highly regarded by their peers.

Understanding Fly Behavior
Studied how apple maggot, hawthorne maggot, and dogwood maggot, all the same species of *Rhagoletis* flies, recognize their respective host plants. Entomologists at GENEVA showed that the flies respond to chemical mixtures in the odor of their host fruit and identified the key mixtures through flight tunnel tests. Researchers also found that some chemical mixtures in the odor of non-host fruit were antagonistic to the flies, and may have a use in repelling them. Now, they are investigating whether this discovery has potential as a pest management tool.

Entomologists Wendell Roelofs (l) and Charles Linn (r) assess fruit volatiles that attract and repel apple maggots as potential pest management tools.

How Do You Like Those Potatoes?
Identified starch content and starch granule size as major factors in the firmness of potatoes that have been heated in water. Scientists determined the relationship between starch content, duration time



Food scientists Seung Lee (l) and Andy Rao (r) research potato starch content to provide information on firmness that is valuable to the French fry industry.

and temperature of the water, and final firmness. Blanching, or heating briefly in water, is an important part of frozen vegetable processing used to preserve color, flavor, and texture. This research will allow food processors to choose the optimum conditions for the desired firmness of potatoes based on the their starch content. Each year, more of the U.S. potato crop is used for frozen products like French fries than for any other purpose.

Developing Partial Cross-Resistance
Proved that the use of one class of fungicides predisposes the apple scab fungus to resistance to another type of fungicide. Further study disproved the conventional view that such properties resulted from similar mechanisms for resistance to the two chemicals. Scientists at GENEVA showed that resistance to one fungicide actually speeds mutation and selection for an unrelated resistance. The information has important implications because it was previously thought that alternating the two fungicides would delay resistance. The discovery may be relevant to the development of multiple antibiotic resistance in human diseases.

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