TECHNOLOGY TRANSFER

50 Inventors Receive Patents

At its 2001 Annual Inventors Luncheon, NC State honored 50 faculty inventors receiving U.S. patents in 2000. Luncheon speaker John Ciannamea, senior managing director of the Academy Venture Fund, said, "The rapid increase in the number of patents in the past several years is a sign that NC State faculty, in large part due to partnerships with industry, are growing much more innovative and focused on solving real-world problems."

The following professors, shared the 25 patents issued, eight of which were for genomics discoveries. George C. Allen*, Woodward Bailey, B. Jayant Baliga*, Ronald Baynes, Griff Bilbro, Ruben Carbonell*, Daniel Comins, Frederick Corbin, Margaret Daub, Robert F. Davis, Joseph DeSimone, Ralph Dewey, Marilyn Ehrenshaft*, E. Allen Foegeding, Fred Gould, Dieter Griffis, Ronald Gyurcsik, Walter Hendrix, Anne Jenns, Arthur W. Kelley, George Kennedy, Peter Kilpatrick, Robert E. Meyer, Gerardo Montero, H. Troy Nagle, Brian Novick, David O'Malley, Nirmala Rajbhandari, Injong Rhee, Jim Riviere, George W. Roberts, R. Michael Roe, Phillip Russell, Jan Schetzina, Ronald Sederoff, Balazs Siminszky, Josip Simunovic, Brent Smith, Wesley Snyder, Terrance Stark, Anne-Marie Stomp, William F. Thompson*, Robert G. Upchurch, Tsvetanka Zheleva.

* *Awarded two patents*

RESEARCH AND GRADUATE STUDIES AT NCSU RESULTS

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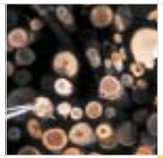
NC STATE UNIVERSITY



Volume I, Number 1

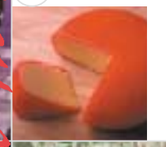
RESULTS

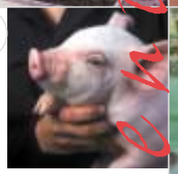
FALL 2001

RESEARCH AND GRADUATE STUDIES AT NORTH STATE CAROLINA UNIVERSITY

NC STATE'S NICHE IN THE AGE OF GENOMICS

Thanks to media attention to the Human Genome Project, the public is beginning to have a broad understanding of the promise of genomic sciences. Put simply, genomics is the study and mapping of DNA and the genes that determine health, behavior and physical characteristics in humans, plants, animals and microbes.





NC State finds itself in a position to be a leader in the field of genomic sciences—but in a unique niche. Cutting edge research in veterinary medicine, agriculture and forestry puts NC State's faculty on the front lines generating some of the earliest true benefits of genomics: crop improvement, food safety, animal health, forest bioengineering, disease and pest control, and waste remediation.

A major strength in bioinformatics has put NC State among the top universities in the world in handling and analyzing extremely large sets of genomic data. With the largest bioinformatics degree program in the country, NC State takes the lead in educating the new bioinformaticians who will enable functional genomics scientists to understand the results of their work. Equally important is the advent of advanced degree programs and fellowships in functional genomics, as well as training programs in biotechnology and bioethics. Comparative biomedical research at the College of Veterinary Medicine and the College of Agriculture and Life Sciences puts NC State in an important contributing position for advances in human health as well. Using animals as models, researchers are working on cures for human diseases such as muscular dystrophy, degenerative myelopathy and HIV.

Grant support for 130 faculty doing genomic sciences research at NC State has averaged $26 million per year for the past two years, and is growing as new facilities open. Between 1998 and 2004, NC State will have invested more than $130 million in buildings and renovations that serve genomics research and education. This has been made possible by state appropriations, university borrowing, grant overhead and, most importantly, the University Improvement Bonds referendum passed by North Carolina voters in 2000.

In this issue of *Results*, and the next, are stories of some of the most successful of NC State's genomic sciences programs to date. ■

Cutting-edge research in veterinary medicine, agriculture and forestry puts NC State's faculty on the front lines generating some of the earliest true benefits of genomics.

RESEARCH AND GRADUATE STUDIES AT NCSU

RESULTS

http://www.ncsu.edu/research/results

Welcome to the first issue of *Results*. This newsletter and its companion Web site seek to inform you about some of the exciting cutting-edge research and innovative graduate programs that are part of this leading science and technology university.

We've chosen Genomic Sciences as the major theme for our first two issues because it's a field in which NC State has made tremendous strides in the past few years, largely without publicity. As you will see, not all genomics research and development takes place in medical schools and genomics companies. Like other universities in the Triangle, NC State has made a very substantial investment in genomics in the past three years. Through NC State's strengths in science, engineering, technology, veterinary medicine, agriculture, forestry, environmental science and bioinformatics, we've found our unique niche in the Age of Biology.

In this issue, you'll find examples of our work in bioinformatics and functional genomics related to human and animal health, food safety, crop health and ecobiotechnology. In addition, you'll see how new grants, graduate degree programs and training curricula are preparing our students for bright futures in genomic sciences. You'll also begin to see the payoff from NC State's investment through new genomic sciences faculty, research programs, curricula and economic development successes.

Each issue of *Results* will also include administrative profiles from Research and Graduate Studies. This issue features our Office of Technology Transfer and the Academy Centennial Fund. With OTT near the top of the national rankings, we're receiving and licensing more patents in genomics and other technologies, spinning off more companies, and nourishing them toward success with technology incubators and venture capital. This all adds up to a more enriched learning environment for our students, as well as financial returns for our faculty and institution.

We welcome your comments and suggestions on *Results* and the news it brings to you.

Charles G. Moreland
Vice Chancellor for Research and Graduate Studies

DR. TODD R. KLAENHAMMER

Food Safety

Klaenhammer Elected to NAS

Dr. Todd R. Klaenhammer, William Neal Reynolds Professor of food science and microbiology, has been elected to the National Academy of Sciences (NAS). Election to membership in the NAS is considered one of the highest honors that can be accorded a U.S. scientist. The NAS, signed into being by Abraham Lincoln in 1863, has included eminent scientists from Albert Einstein and Alexander Graham Bell to Carl Sagan and James Watson.

Klaenhammer is one of 72 U.S. scientists elected to the prestigious academy this year, and the first food scientist ever to become an NAS member. His election brings to nine the number of current NC State faculty who are NAS members. The university also has 10 current faculty who are members of NAS' peer institution, the National Academy of Engineering. See the entire list at *www.ncsu.edu/research/results*.

Klaenhammer is director of the Southeast Dairy Foods Research Center at NC State, and is one of the world's leading experts on the beneficial roles of lactic acid bacteria, which are used to preserve foods and prevent the growth of food-borne pathogens. He is widely cited for his seminal research to develop gene-based defenses that prevent viruses from infecting the beneficial bacterial cultures that ferment milk into cheese.

Klaenhammer's research group is also internationally recognized for its genomic studies on *Lactobacillus* cultures that are beneficial in the human gastrointestinal tract. Genomic information is being used to understand how these beneficial bacteria survive passage through the stomach, enter the intestines, and produce various benefits, including improved digestion and stimulation of the immune system. ■

www.cals.ncsu.edu/food_science/trk/main.html

FUNCTIONAL GENOMICS

"A Funding Booster Rocket"

One of the university's latest bragging rights is its new Genome Research Laboratory (GRL) on the Centennial Campus. The GRL is a $4-million laboratory/office suite outfitted with automated DNA sequencers, lab robotics, and a complete system for the preparation and analysis of microarrays (assays for large numbers of genes). Ask Dr. Charles Opperman, professor of plant pathology and GRL co-executive director, and he'll modestly tell you that it's one of the finest facilities of its kind in the country.

"The GRL is the only publicly funded, broad-spectrum genomics facility in the state and the only completely user-driven facility of its kind in the U.S.," says Opperman. Used in more than 100 research programs at NC State, the lab has still not approached its 17,000-reaction-per-week capacity. But it has already justified its cost risk. After its first year, the facility has given researchers in agriculture, life sciences and natural resources the necessary competitive advantage to win $19 million worth of genomics research grants.

"It is highly unlikely that these grant applications would have been successful without access to the technology available in the GRL," comments Dr. Bill Thompson, a professor of botany and the other half of the faculty executive director team. "This lab acts as a funding booster rocket."

Dr. Bryon Sosinski, the GRL's on-site director and a research assistant professor of horticulture, runs down the menu: "Our facility allows researchers to do high throughput sequencing, cloning, library construction, colony picking, filter spotting, microarraying, informatics and data mining for any research program at NC State that needs these very specialized and expensive tools. The user-based nature of the GRL saves everyone money and provides an important educational function for graduate students."

The lab is continuously retooling to stay ahead of genomics faculty equipment needs and still has expansion space. Says Thompson, "The new biology requires a big investment in equipment. The GRL exemplifies the university's commitment to excellence in the field of genomic science." ■

Dr. Bryan Sosinski discusses sequencing results with graduate student intern Monica Murphy. ●

www.cals.ncsu.edu/grl/

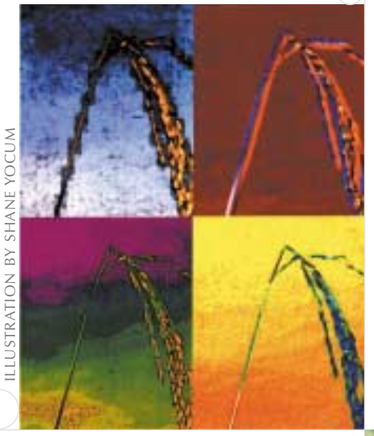


ILLUSTRATION BY SHANE YOCUM

Rice stalk with rice blast disease at neck

Protecting the World's Food Supply:

DECODING THE FUNGUS AMONG US

DR. RALPH DEAN

Most of us don't feel the need to know everything about any fungus. Not so in Dr. Ralph Dean's world. Dean is a professor of plant pathology, and the founding director of NC State's new Fungal Genomics Laboratory (FGL). A relatively new faculty member, Dean is a great example of the genomic sciences research and teaching faculty attracted to NC State in the past few years.

Dean was recruited in 1999 from his position as associate director of the Clemson University Genomics Institute, an international center dedicated to applying genomics research to improve crop plants. He was able to transfer about $500,000 in research funding to NC State. Since arriving, he has brought in an additional $11.1 million in government and industry funding, making the FGL the world's best funded, most cutting-edge laboratory addressing fungal genomics at a public university.

According to Dr. Johnny Wynne, associate dean for research in the College of Agriculture and Life Sciences, "This is what we were counting on when we took the risk of building Ralph a million-dollar office and laboratory suite on our Centennial Campus. We wanted the FGL to have what it needed to be the best." Dean's lab shares a new research building with the Bioinformatics Research Center and the Genome Research Laboratory, two university facilities with brainpower and millions of dollars of equipment that support the FGL and other genomics work at NC State.

A primary target of the FGL is the understanding of the interaction between rice and the rice blast fungus, *Magnaporthe grisea*, one of the main pathological threats to food supplies world wide. Enough rice is lost to the disease annually to feed 60 million people. Strains of the fungus attack other cereals including wheat and barley. It's a major pestilence, particularly in developing countries.

In 1998, Dean helped launch the Rice Blast Genome Initiative, an international consortium with members from the United States, Europe and Asia pursuing genome sequencing and function for this important fungal pathogen. Long concerned with mechanisms of fungal disease and gene discovery work, he has specialized his research for this project, looking for the genes that are critical to rice blast disease and potential targets for intervention. "Simply put," Dean says, "the question is: What is being produced by the rice blast fungus that is affecting the host plant?"

After characterizing several important genes, FGL staff have taken a more global approach to the study, mapping and studying the expression patterns of 400 genes from one of the rice blast's seven chromosomes. The next step is to identify all the genes in the organism. "This has opened up the field of how fungal organisms perceive the environment and has put us in a groundbreaking position for elucidating the molecular basis of plant disease in general," says Dean.

Dozens of other labs around the world are emulating the FGL's strategy. "We're right at the top of the pile," Dean likes to say. But that was not his real goal. He's really going after curbing world hunger. ▪

www.fungalgenomics.ncsu.edu

ENOUGH RICE IS LOST TO RICE BLAST DISEASE ANNUALLY TO FEED 60 MILLION PEOPLE. IT'S A MAJOR PESTILENCE, PARTICULARLY IN DEVELOPING COUNTRIES.

CROP HEALTH

WORKFORCE DEVELOPMENT

Jiangying Liao and Daniel Snyder practice techniques at the Biotechnology Education Facility

NEW TRAINING OPPORTUNITIES FOR BIOTECH'S NEW JOBS

www.ncsu.edu/biotechnology

NC State University has become the first in the Research Triangle to offer master's and doctoral degrees in genomic sciences—and is one of the first in the nation to focus on genomics from the perspectives of statistics, computer sciences, forest resources, agriculture, life sciences and veterinary medicine. A comprehensive slate of new genomic sciences degree programs, fellowships and training programs is giving NC State students the right stuff to meet the demand for scientists in the genomic sciences era.

The university has been awarded more than $4 million in the past two years from government agencies and the UNC Office of the President to support graduate students pursuing degrees in functional genomics and bioinformatics. The funding supports 49 fellowships for graduate students per year. "This is a very special and important aspect of biotechnology teaching at NC State," says Dr. Barbara Sherry, professor of virology in the College of Veterinary Medicine and director of the Genomic Studies Graduate Program. "The new programs span multiple departments, offering students opportunities to cross traditional boundaries to learn more about the many interdependent areas within functional genomics and bioinformatics."

Rounding out the choice of graduate degree programs in genomic sciences is the Biotechnology Training Program, funded by NIH with matching funds from the university. This program is offered to any Ph.D. student, regardless of major, to enhance research and training experience in biotechnology beyond the exposure provided by their doctoral programs. Trainees complete courses for a minor in biotechnology, attend professional development seminars and symposia, serve an industry internship for at least one month, and complete a service project involving K-12 biotechnology education.

In addition to the graduate programs, a new university-wide undergraduate minor in biotechnology has been developed for NC State students. A fully renovated Biotechnology Teaching Facility opened its doors in Jordan Hall this semester. The new teaching lab provides a state-of-the-art learning environment complete with a DNA sequencer, a genomics workstation, a computer laboratory, and individual laboratory stations for up to 40 students at a time.

A key part of both graduate and undergraduate genomics programs is a required ethics course designed to promote critical thinking about the complex ethical and social issues that accompany work with genetically modified organisms. The NC State Graduate School received NSF funding in 1999 to implement a research ethics program including instructional modules, Web information, lectures by exemplary researchers, biennial institutes for faculty, a Research Ethics Fellows program and formal seminars. ▪

NC STATE IS ONE OF THE FIRST UNIVERSITIES IN THE NATION TO FOCUS ON GENOMICS FROM THE PERSPECTIVES OF STATISTICS, COMPUTER SCIENCES, FOREST RESOURCES, AGRICULTURE, LIFE SCIENCES AND VETERINARY MEDICINE.

"If we can bioengineer fast-growing, high-yield trees with other specialty features and grow them as crops, we can largely leave the natural forests alone. It's doable and it will be profitable."

—Dr. Ronald Sederoff

A PLAN FOR

LETTING OUR NATURAL FORESTS BE

DR. RONALD SEDEROFF

Just as we're hearing the news of the first functional genomics discoveries, Dr. Ron Sederoff, distinguished university professor and director of NC State's Forest Biotechnology Laboratory (FBL), is already pushing toward what the world needs next. "It is now time to use what we already know of genomics to accomplish economically important social goals," says Sederoff. "Researchers are already using many genomic sciences discoveries for applications in human, animal and crop health. It's time for us to work harder on environmental health."

For example, Sederoff says, "If we can bioengineer fast-growing, high-yield trees with other specialty features and grow them as crops for human needs, we can largely leave the natural forests alone. It's doable and it will be profitable in many ways." He cautions, however, that any crop of genetically modified trees would also need to be engineered to restrict its ability to cross-pollinate, thereby preserving the genetic integrity of existing forests.

Many environmentally important uses of genomics discoveries are subjects of intense development in other programs at NC State: rescuing endangered species; bioremediating waste; encouraging biodiversity, and protecting ecosystems. Sederoff is proposing a full frontal attack on the big picture of deforestation, habitat destruction, and climate change through a rapid acceleration of the "domestication" of trees, or the modification of trees to solve environmental problems.

Domestication of trees is not a new idea to forest biotechnologists, but most agree that the process could be rapidly accelerated with appropriate funding from federal and state governments. "It took thousands of years for humans to domesticate plants through the use of plant breeding," Sederoff says. "We can't wait that long to preserve the world's natural forests."

As one way of speeding things along, Sederoff has teamed with Dr. Hou-Min Chang and several other NC State researchers on a newly granted $3 million U.S. Department of Agriculture project. If successful, researchers will use what is already known about the pine tree genome to improve the loblolly pine to produce more wood on less land in less time.

The FBL, which largely focuses on the pine tree genome, is the oldest and one of the largest tree genomics groups in the world. It is the only large-scale tree genomics project sponsored by the National Science Foundation (NSF).

In July 2000, the FBL moved to a new $3 million facility, co-locating with other major genomics research and service laboratories. Within the time it took to upfit and equip the new building, the FBL and collaborating researchers had parlayed the promise of the new laboratory and its partnerships into a three-year, $4.4-million grant from NSF.

The laboratory's research group, which now consists of 41 faculty and staff members, post-docs, graduate students and technicians, has published 80 papers in leading scientific journals, authored a book and received six patents. Having attracted more than $18 million in external funding since its inception in 1985, the FBL has a $2.3-million budget this year. It has developed one of the world's most advanced systems for genetic mapping using amplified DNA fragment technology and automatic DNA sequencers.

Sederoff and members of the FBL Research Team

"It's our responsibility as a leader in research to move our results into applications as rapidly as possible," says J.B. Jett, associate dean for research in the College of Natural Resources. "The excellence of our forest biotechnology researchers is putting us in reach of the goal Ron and others have laid out." ■

"We can't wait thousa nds of years to preserve the world's natural forests."

DR. BRUCE WEIR

SHAVING YEARS OFF THE DISCOVERY PROCESS

BIOINFORMATICS

NC State is one of the world's major training centers for bioinformaticians.

Spectacular advances in experimental molecular biology led to the determination of the human genome sequence. But data mining of the full implication of the sequence was made possible because of advances in a new field called bioinformatics. Operating at the intersection of computer science, statistics and genomics, bioinformatics enables the Human Genome Project and thousands of other biotechnology projects in labs around the world to make sense of the massive amount of data they generate.

"Managing information from 34,000 sequenced clones to produce the final 2.7 million base pair sequences in humans represents a scientific achievement comparable to the gene sequencing techniques themselves. Bioinformatics shaves years off the discovery process," says Dr. Bruce Weir, Reynolds Professor of Statistics and Genetics, and director of NC State's new Bioinformatics Research Center (BRC). The center opened this year on NC State's Centennial Campus, adjacent to the Genome Research Laboratory, the Fungal Genomics Laboratory, the Forest Biotechnology Laboratory and other genomics research programs.

Key to the center is the involvement and training of graduate students. *Newsweek* magazine (April 30, 2000) reports an estimate that "the bioinformatics industry will need 20,000 highly trained workers by 2005—a new brand of super-geek who understands the complex tongues of biology, statistics and computer science." Because of the concentration of agriculture and medical research companies in the Triangle, hiring is especially competitive here.

With the largest bioinformatics degree program in the country, NC State is one of the world's major training centers for bioinformaticians. "Our students are being snapped up by industry as fast as we can train them," says Weir. NC State's Department of Statistics also offers a Summer Institute in Statistical Genetics, funded by the National Science Foundation and the National Institutes of Health (NIH). The Summer Institute is open to students worldwide and is taught by an internationally distinguished faculty from academia and industry.

> "NC State's bioinformatics program was ready when DNA research became the genome revolution."
>
> Chancellor Marye Anne Fox

Weir also serves as the director of the university's Statistical and Quantitative Genetics Research Program. Industry funding for this program has doubled during the past five years. A $6 million grant from NIH in January marked the 42nd year of continuous NIH funding for NC State research in statistical and quantitative genetics, and brings total NIH funding for the program to more than $25 million. "It's a remarkable show of confidence by NIH in the excellence of our statistics and genetics faculty," says Chancellor Marye Anne Fox. "Because of world-class published research, NC State's bioinformatics program was ready when DNA research became the genome revolution."

As both a service and educational strategy, the BRC maintains an open invitation to faculty and industry researchers to bring bioinformatics problems to the group's coffee break any day at 10 a.m. "It's a very interesting way to involve students in the creative process as we toss around ideas for solutions," says graduate student Errol Strain, working in the BRC under a training grant from the National Institute of Environmental Health Sciences.

The 50 faculty, staff and students at the BRC perform basic research and interact with producers of data, both on and off campus. The mission of the center is to develop and implement methods for the management and interpretation of genomic data—with an emphasis on agriculture, forestry and veterinary medicine. By working closely with other groups at NC State, and with research organizations and companies in the Research Triangle area and beyond, the BRC plays a key role in ensuring that the genome revolution translates into benefits for the citizens of North Carolina. ■

statgen.ncsu.edu/bioinformatics/

Partners Building II, home of NC State's newest Genomic Research Centers

NC State's Toxicology Building on Centennial Campus

www.ncsu.edu/research/results

facilities

FACILITIES:

KEY TO GENOMIC SCIENCES RESULTS

When NC State faculty and administrators first looked at throwing their hats into the genomics research ring several years ago, the most serious potential stopper was the need for major investment in new buildings, laboratories and equipment. While that concern is always present in a growing research enterprise, today's view across the NC State genomics landscape shows what can happen when NC State's chancellor and deans unanimously decide to turn a faculty vision into a priority.

More than $130 million has been committed to facilities and equipment for genomics research and teaching at NC State between 1999 and 2004. These investments have been made possible by State appropriations, university borrowing, grant overhead and, most importantly, the University Improvement Bonds package passed by voters in 2000. This has provided the leverage needed to attract government and other external support for an impressive range of world-class genomic research and teaching facilities. Significant grant overhead receipts have been focused on genomic sciences facilities and equipment as well.

"A big advantage in this effort," says Dr. Bob Kelly, associate vice chancellor for research and director of NC State's Biotechnology Program, "is the fact that we have available land and new buildings on the Centennial Campus (NC State's science and technology research park), along with the ability to borrow funds for additional, grant-supported buildings. It saves time in getting new facilities on line and therefore makes NC State more competitive in attracting top faculty, students and research funding."

Also key is the deans' and faculty's strategic determination to share biotechnology and genomic sciences centers and support facilities across college, department and program lines. This has not only helped to avoid unnecessary duplication of costly facilities and equipment, but also allowed for purchase of some of the best equipment available. For a list of the shared resources available to genomic sciences faculty throughout the university as of this writing, please refer to the Results Web site at *www.ncsu.edu/research/results*. ■

The

"NEW NC STATE" MODEL

"This is not your daddy's NC State when it comes to research," warns Vice Chancellor for Research Charles Moreland. In the past 10 years, NC State's model of industry partnerships in innovation, entrepreneurship and economic development has become so successful that the university has received a $500,000 grant from National Science Foundation to document and disseminate the model to other universities.

THE NC STATE MODEL INCLUDES:

- Inventors;
- Sponsored research funds and/or industry partners;
- Technology transfer advising, patenting and licensing;
- Technology incubator facilities at Centennial Campus;
- Seed stage venture capital;
- Professional advice, fund-raising support, and consulting on growth strategies for entrepreneurs;
- Returns on equity for university, company, inventor and investor; and
- Contributions to the public good and local economic development.

The Entrepreneurial Development Center at NC State •

"The real key has been the development of our seed stage venture capital fund, Centennial Venture Partners (now renamed Academy Centennial Fund), which has grown to a family of three progressively larger seed funds," Moreland says. "Since most university spin-offs aren't really ready to go after major venture capital, this seed stage fund helps fund the companies through the early period of developing a business plan, proving the concept, attracting experienced management talent, and developing a commercialization plan that will appeal to larger funds."

The proof of the fund's success, says Glenn Kline, managing director of Academy Funds, is that the money and guidance invested by the Academy Centennial Fund over the past three years have helped its client companies attract 12 times that amount from other, larger funds. In addition, the value of Academy Centennial Fund's portfolio of companies is now three times what it was when it started. An unexpected bonus is that the companies that started with the fund's support have already contracted with NC State faculty for more than $1.5 million in research.

"The reason we've been so successful," says Kline, "is that the chancellor and vice chancellor for research at NC State are so supportive of the model and have a willingness to blaze new and creative trails. I think this signals to the entrepreneurs and the public that moving value from academia to the public is part of the big picture at the 'New NC State'." ■

#1 in the ACC!

A report from the Southern Growth Policies Board (SGPB) has placed NC State's Office of Technology Transfer in a three-way tie for its best-in-class ranking following a study of technology transfer operations at 72 research institutions in the United States. Johns Hopkins University and the University of Georgia also tied for the top. "It's great to be Number One in the ACC," joked Vice Chancellor Charles Moreland, "and we're certainly in great company."

The report is the fourth in a series of performance benchmarking efforts undertaken by the SGPB with NSF support. Performance information was collected in three general areas: patent award rates; license rates and royalty income; and the number of new companies started based on university technologies and other economic impact measures.

In 2000, the Association of University Technology Managers ranked NC State fourth in the nation in the number of start-up companies established, just behind Stanford, MIT, and the University of California's nine-campus system. According to David Winwood, assistant vice chancellor for technology transfer, "The current year has been the biggest year ever for number of spin-offs from NC State, and will likely lead to a further upgrade in the university's national ranking in technology transfer activities." ■

VET MED'S CONTRIBUTION TO THE BATTLE AGAINST HIV

Could clues to the cure for HIV come from studies of cats? A team of scientists in the Department of Microbiology, Pathology and Parasitology in NC State's College of Veterinary Medicine think they might.

Drs. Mary and Wayne Tompkins, Gregg Dean and Mary Jo Burkhard make up a world-renowned National Institutes of Health-funded research team studying Feline Immunodeficiency Virus (FIV), a member of the HIV virus family. The research Drs. Tompkins, Burkhard and Dean, along with eight graduate students, are conducting will not only provide important knowledge for prevention and treatment of a major cat disease, but also help develop a vaccine and other therapies that might transition to human medicine.

"What most people understand about HIV is that the carrier of the virus experiences a loss of a cell population called T-cells. These cells are necessary to initiate an immune response to protect individuals against infectious agents," explains Mary Tompkins. "If you don't have many T-cells, then you will have trouble mounting an immune response to any harmful germs. HIV slowly wipes out the infected person's T-cells. Eventually, it's impossible to fight off any illnesses."

Part of the FIV Team (L to R): *Mary Jo Burkhard, Wayne D. Tompkins, Mary Tompkins* •

FIV-infected cats go through the same sort of disease syndromes as humans with HIV. Unlike HIV, which was most likely contracted from monkeys, FIV is a naturally occurring infection in cats. This means that the virus has been in the cat population for many years. As with humans, symptoms may be delayed for years. The main difference between HIV and FIV is the method of transmission. In general, FIV transmission occurs through bite wounds, not through sexual contact. (FIV cannot be transmitted to humans.)

Burkhard has developed a model of FIV transmission in vaginal mucosa of cats and is researching the cells harboring and transmitting the virus in their oral, vaginal and rectal mucosa. Her search for a way to interrupt the transmission of FIV in mucosa could lead to a method of stopping HIV-positive mothers from infecting their babies during birth and nursing.

Viral genome research done by the FIV team is essential to discovering more about the transmission of viruses. Through partnerships with Triangle-area companies AlphaVax and Trimeris, as well as multinational companies such as Fort Dodge Laboratories, Schering Plough and Pfizer, NC State's FIV research has become a very important component of HIV/AIDS research. "We must understand the genomics of pathogens in order to discover cures for disease," explains Dr. Gregg Dean. "Coaxing immune systems to respond to pathogens is key to creating a vaccine for FIV and HIV."

Wayne Tompkins summarizes, "A major current focus of our research is to determine how FIV/HIV infection destroys the T-cell immune system. As we unravel the mystery of how these viruses impair the immune system and cause AIDS, we will be in a stronger position for designing vaccines to prevent the diseases, as well as therapeutic modalities to treat them." ■

Feline Musosal T-cells •