

# AgriS&T

Technology Information for Development

APRIL 2002 – YEAR 1 – NUMBER 001



## New concepts in Brazilian agriculture

Research helps Brazil trace products  
to meet the demands of international markets

# LABEX.

Strengthening  
research,  
surmounting  
frontiers



LABEX – EMBRAPA Overseas Laboratory is a pioneering initiative whose purpose is the exchange of scientific and technological information among Brazilian and foreign research centers. LABEX shares the facilities, equipment and research teams of partner organizations, generating an unprecedented, dynamic interactivity that broadens and strengthens scientific cooperation. EMBRAPA has already installed laboratories at Montpellier, in France, and at Beltsville, in the Department of Agriculture, in the United States. The outcomes of this undertaking are translated into technologies, products and services that not only benefit agribusiness but also promote improvements in the quality of life of the Brazilian people.

MINISTRY OF AGRICULTURE,  
LIVESTOCK AND FOOD SUPPLY

**Embrapa**

Brazilian Agricultural Research Corporation

**BRAZILIAN  
GOVERNMENT**

## DEAR READER:

This is the first number of the **AgriS&T** magazine, whose purpose is to help keep society informed about the progress made by Brazilian agriculture and its contribution to the development of the country. Although **AgriS&T** is published by EMBRAPA under the sponsorship of the Ministry of Agriculture and Supply, it is not a publication exclusively about the company. **AgriS&T** is first and foremost a channel to disseminate information about the work of all those engaged in Science & Technology and Innovation, developing and using products and processes of strategic importance for Brazilian agribusiness. It is a complex task, given the number and quality of the topics, which vary from family agriculture to satellite monitoring, from microbiology to the environment, and involves basic science institutions as well as organizations engaged in innovation and technology transfer.

EMBRAPA hopes that **AgriS&T** will become a point of reference in Brazil and abroad, since it will also be published in English. It should be an instrument to broaden partnerships and promote national and international exchange. Above all else, **AgriS&T** will show Brazilian and foreign consumers that our agribusiness products are supported by a sound and well-oriented technological base.

Brazilian agribusiness has gained recognition throughout the world. Innovative technologies, generated in farms and laboratories for all the regions of Brazil, show that we have mastered the secrets of sustainable tropical and subtropical agriculture. It is not the fruit of a single company, but the result of the efforts of thousands of technicians in hundreds of research and technology-transfer organizations. The following pages will show you part of this important work.

**Marcus Vinicius Pratini de Moraes**  
Minister of Agriculture and Supply

# AgriS&T

Technology Information for Development

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# Farming and its new concepts

**In addition to quality, food must aggregate new concepts such as sustainable production techniques, environmental protection and social justice. These are the new rules of international markets**

An alert has sounded in Brazilian farms at the request of consumers in developed countries, particularly in Europe. Before buying a product, they want to know everything about its origin, the quality of the water, the amount of pesticides used, and their impact on the environment. They want to know about the health and safety of the workers who produced it, and whether its production helps generate income and jobs for small farmers. And much, much more. Consequently, the labels of the products on supermarket shelves are providing a wealth of information. Some market niches, indeed, require seals attesting the product to be "ecologically" or "socially" correct. Seen from another angle, people are consuming more than just the product itself. They are ingesting "quality of life", preoccupied with the consequences that the mere purchase of a product might bring about in the global production system.

Among the European Union's new rules to meet such demands, those pertaining to meat imports will come into effect, partially, during the second half of 2002 and fully in 2003, when the new fruit standards will also become effective, only to turn even more rigorous in 2005.

These changes are already affecting agro-industrial production in Brazil, beginning with the implementation of a new concept - **traceability**, which signifies a series of information about a product, from the beginning of production (purchase of seedling, in the case of fruit, or birth of the animal, in the case of meat) to post-harvest treatments or slaughter and meat packing processes. To that end, the country is investing heavily in the generation, adaptation and transfer of technology and the training of producers, since it is not a simple matter and requires cultural changes in each producing region. Traceability requires transparency about the location of the farming operation, crop management, use of irrigation, and levels of pesticide residues. For each crop, there are rules established for the whole agro-industrial process.

A certifying company will be in charge of monitoring. The National Metrology Institute (INMETRO) will accredit the certifying company. In the case of fruit, INMETRO will issue a seal of quality. The Secretariat for Animal Health of the Ministry of Agriculture and Supply will accredit certifying organizations in the Brazilian System of Identification and Certification of Bovine and Buffalo Products (SISBOV). ■

## Bits of Knowledge

Although the word cannot be found in any Portuguese language dictionary, *rastreadabilidade* is very popular in the daily life of ranches and beef cattle breeders, as well as in universities and research centers, and in beef import and export contracts and transactions. It comes

from the English term "traceability", i.e., the ability to trace, to follow clues, evidence, or tracks. To trace is to monitor, follow up, or control something or some information. Although they are different words, the purpose of tracing or of a traceability policy is the same: identifying a given animal.

DELEEN MARTINS



**Producers unprepared to use these technologies and sell food security may be left out of the meat agribusiness.**



## Cattle with chip in the age of hi-tech ranching

The European Union receives 80% of Brazilian meat exports. It is the first economic block to demand traceability as a barrier against food imports. All meat imported by European countries must be accompanied by information about its origin, where the animal was born, its genealogy, how it was managed, what it ate, where it lived, which diseases it had, whether it was vaccinated, which drugs were administered, whether male or female, and age at slaughter. Information is the leading feature of this new order, and producers unprepared to use these technologies and sell food security may be left out of the meat agribusiness.

Brazil already masters meat tracing techniques. Early this year, the Minister of Agriculture and Supply of Brazil, Marcos Vinicius Pratini de Moraes, launched the Brazilian System of Identification and Certification of Bovine and Buffalo Products (SISBOV), with monitoring information about all the phases of cattle production, from birth in the ranch to slaughter in meat packing houses. EMBRAPA was selected as the first SISBOV certifying organization. Brazilian cattle, beginning with the beef to be sold in the European market, will be monitored on the basis of individual identification devices, such as branding, tattoos, ordinary or electronic earrings, transponders (chips), etc. Research is already contemplating DNA tests.

More than six years ago, even before the European Union warned that it would require traceability, researcher Pedro Paulo Pires and his team at EMBRAPA Beef Cattle began developing an identification system, testing existing models, thinking about possible adaptations and adjustments

in the devices, and identifying the most adequate site to introduce the chip in the animals' body. What began as an efficient tool for property control - including preventing cattle robberies - became a herd-management instrument. Outcome: when the European Union required cattle traceability, EMBRAPA already had the right solution, at the right time.

An electronic chip is a device that operates like a bobbin activated by electronic waves, emitting an international signal that is captured by an aerial or stored in a computer. The identification will feed a database holding all the information about the life of the animal. In the case of adult animals, which are just coming

into the traceability program, the chip is deposited in the rumen. New-born animals receive the chip through the umbilical opening. The chip will only be removed from the umbilical fold or the rumen at slaughter, when the animal's number is deleted from the database. If the identifying chip is lost, the animal is excluded from the tracing program and its meat will not reach European ports or restaurants. Cost is another advantage, since the device can be used more than once.



**When the European Union required cattle traceability, EMBRAPA already had the solution.**

The electronic identification chip for cattle is being distributed in Brazil by the representative of the American manufacturer, Destron Fearing, which pays EMBRAPA royalties. Unit price varies from US\$ 2.80 to US\$ 3.20 and the trend is for the price of the device to drop when companies start competing. Although SISBOV and the certifying companies leave ranchers free to adopt any identification device, the EMBRAPA transponder is now the safest device in the market for the conditions that prevail in tropical production systems. ■

## "Cowboy's keyboard"

The "cowboy's keyboard" is another tool developed by EMBRAPA. It consists of a panel with various electronic devices, whose purpose is to obtain information easily when trying to trace cattle in the ranch. The panel changes functions when the cattle is being submitted to various activities at the same

the time (such as vaccination and weighing) and it becomes necessary to identify the lots, separately, by management or treatment. Only the devices that make the readings and store the animals' identification data need to be taken to the field - the computer stays in the office.

It is easy to operate both in the field and the office. When the cowhand points to a function programmed in the panel, the datum is stored in the portable station. At the office, the software receives the data, opens a window in the monitor and processes the information. ■



Integrated Fruit Production technology has already reached cashew

The concept of traceability in the Brazilian fruit export market is directly linked to the Integrated Fruit Production (IFP) system, which is a sort of recipe to improve the quality of the crops, to the benefit of the external market. In order to guide growers in the implementation of the Integrated Fruit Production system, rules are being developed for each type of crop, while a certifying company, accredited by the National Metrology Institute (INMETRO), will be in charge of monitoring. INMETRO will also issue a quality seal. Four EMBRAPA units have been involved in the studies on the Integrated Fruit Production system, with the participation of

## Monitoring fruit

partners from the private sector, cooperatives and associations, state and municipal agencies, and universities.

This pioneering project began in 1997, under the coordination of EMBRAPA Grape&Wine, focusing initially on apples. The research was carried out in 100 hectares of orchards in the South region of the country. After defining the rules of integrated production, the growers themselves, in the states of Paraná, Santa Catarina and Rio Grande do Sul, decided to hire technical personnel and set up additional integrated fruit production areas, which today add up to 8,000 hectares. This corresponds to almost 30% of apple orchards in Brazil. According to researcher Alexandre Hoffman, the integrated apple production system will be available in the market for the 2002/2003 harvest, including the certification of companies in the system.

**Mangoes and grapes** – In the Northeast of Brazil, the integrated production of mangoes and grapes was initially discussed with growers in the São Francisco river valley in 1999, under the coordination of EMBRAPA Semi-arid and EMBRAPA Environment and with the support of EMBRAPA Grape&Wine. The outcomes can be seen in 725 hectares of vineyards in 20 farms and 3,170 hectares of mango groves owned by 25 exporting companies. Average pesticide use dropped by approximately 30%.

The Boa Esperança farm, located in the municipality of Petrolina, State of Pernambuco, is a good example of the efficacy of the

system. Fungicide use in the mango grove was reduced by more than 75% after grove management was modified to meet the rules of Integrated Fruit Production. In 2000, there were 21 fungicide applications, while only five applications were made in 2001, explained Karla Consuelo, the farm's agricultural technician. The first quality certificates for those following the integrated production rules will be issued in 2002.

**Cashew and melons** – Cashew and melon are being contemplated with their own integrated production systems in the states of Ceará and Rio Grande do Norte. The studies began early this year, under the coordination of EMBRAPA Tropical Agroindustry. The Ministry of Agriculture and Supply will invest two million reais in the two projects in three years. So that by 2005 Brazil will probably be the first country to export cashew nuts with traceability information. ■



## Social benefits of agricultural research exceed R\$ 7.7 billion

EMBRAPA is releasing the fifth edition of the Social Balance of Agricultural Research - 2001, which has received a prize from the Brazilian Corporate Communication Association (ABERJE). The main outcome is the acknowledgement that the social benefits generated by eight institutions in the National Agricultural Research System (SNPA) exceeded R\$ 7.7 billion last year.

The Social Balance uses methodology proposed by IBASE, the Brazilian Social and Economic Analysis Institute. In order to calculate the social benefit, EMBRAPA used the methodology to evaluate international loan projects from the World Bank and the Inter-American Development Bank. The publication covers the actions of eight research, teaching, development, and rural extension institutions, in various fields, such as family agriculture, land reform, community support, indigenous communities, food security, environment and environmental education, welfare, security, and labor medicine. In addition to EMBRAPA, other institutions participated in the Social Balance - 2001, namely, the Mossoró Agricultural College (ESAM), Agricultural Development Company of Bahia (EBDA), Agricultural Development Company of Sergipe (EMDAGRO), Agricultural Research Company of the State of Paraíba (EMEPA), Agricultural Research Company of Rio Grande do Norte (EMPARN), Agricultural Research Company of Minas Gerais (EPAMIG), and the School of Veterinary Medicine of the Federal University of Minas Gerais (UFMG). ■

ENLOW/WIREFO



Since late last year a new product has been present on the table of Brazilians in the states of Roraima, Mato Grosso, Mato Grosso do Sul, Bahia, and Paraná - "Brazilian" bread, produced with wheat flour and cassava starch using technology developed at EMBRAPA Cassava&Fruits. Researcher Joselito da Silva Motta, one of research team members, is touring the country providing technical support to bakers and teaching them how to replace up to 20% of the wheat flour with cassava starch when making French bread and 25% in the case of hamburger and hotdog buns.

According to Chigeru Fukuda, researcher at EMBRAPA and president of the Brazilian Cassava Society, the use of cassava starch in bakeries would be a safety valve for cassava farmers, particularly family agriculture. "In the Northeast Region, cassava has always been considered a poor-man's crop, without consideration of the important food-security role it plays for low-income populations." EMBRAPA believes in the

viability of the starch/wheat flour mixture from the technical standpoint, although its use should not be legally required.

The president of the Cassava Industry Union, José Reynaldo de Bastos Silva, estimates that the nation-wide use of starch in bread-making could save the country approximately R\$ 200 million per year in the balance of trade. He believes that 50,000 new jobs would be generated in the main cities.

**Consistency** - "With the new formula, bread has a lighter texture, it is not 'rubbery'; and the dough is much whiter", asserts baker Toni Carvalho, from Parati Bakers, one of the first companies to adopt the mixture in Cruz das Almas. The researchers guarantee that there is no significant change in the taste of bread and that starch doubles storage time from three to six hours.

At the Curitiba Temporary Detention Unit, 20 inmates working in the prison bakery will be trained to use 20% cassava starch in the recipe to make 10,000 French dough rolls, with savings of almost R\$ 2,500 per month. ■

## Embrapa publishes portfolio of protected technologies

What are the 40 most important technologies developed and patented by EMBRAPA in the last few years? The answer can be found in the Portfolio of EMBRAPA's Protected Technologies, released in April, during the company's 29th anniversary celebration. "It is an updated and illustrated list of our most recent inventions, such as equipment, processes and products, whose objective is to show what is protected and how that protection is defined", explained

researcher Maria Isabel Penteadó, who coordinated the publication.

The portfolio provides details of the electronic tongue, for example, a sensor to evaluate beverages; a device to measure the diameter of particles; a portable magnetometer to measure the magnetic load of soils; a *Fusarium*-wilt biological control process; a new timber drying process; a low-cost soil humidity measuring device; and a system of biological reactors for cell cultures. ■

## Research prepares flavorless soybean

EMBRAPA researchers are presenting the first soybean variety with a delicate flavor: BRS 213. The new variety lacks the lipoxidase enzymes responsible for soybean's characteristic taste. After eleven years investigating soybean varieties, the researchers believe that BRS 213 is tailored to the Brazilian taste and appropriate for the production of the soluble extract or soybean "milk, as well as other products such as tofu or soybean "cheese"". "The next research target is a variety with an even more delicate flavor, as a result of higher sugar and starch contents", asserts Mercedes Panizzi, a researcher at EMBRAPA Soybean in Londrina, State of Paraná. Other characteristics include the light hilum or spot on the seed and its large size.

The new varieties will be commercially available in 2005. In the mean time,

soybean can be used in human diets using appropriate preparation techniques. "Thermal shocks help eliminate the exotic flavor of soybean", guarantees researcher Marcos Mandarino of EMBRAPA Soybean.

**Isoflavones** - The Chinese have known and enjoyed the benefits of soybean for millennia. In the last few years, however, the western world began seeing soybean as a functional food, i.e., a food that provides nutrients and health benefits. Soybean has a high protein content, as well as unsaturated fatty acids and isoflavones, which help prevent chronic and degenerative diseases. The isoflavones also help prevent some types of cancer, such as



The new soybean variety was tailored to Brazilian taste

breast, cervical and prostate cancer. In addition, they are recommended for diminishing pre-menstrual tension and menopause symptoms. The United States Food and Drug Administration (FDA) recommends taking 25g of soybean protein daily to control blood cholesterol and decrease the risks of myocardial infarcts, thromboses and atherosclerosis. ■

## Redenção tomatoes are resistant to virus infections

After four years of research, the Pernambuco Agricultural Research Company (IPA) has developed an industrial tomato variety resistant to geminivirus, tospovirus, *Stemphylium* leaf spot, and nematodes, which has been named Redenção. The new variety does not require as many pesticide sprayings. Redenção tomatoes, therefore, are healthier and less polluting to the environment.

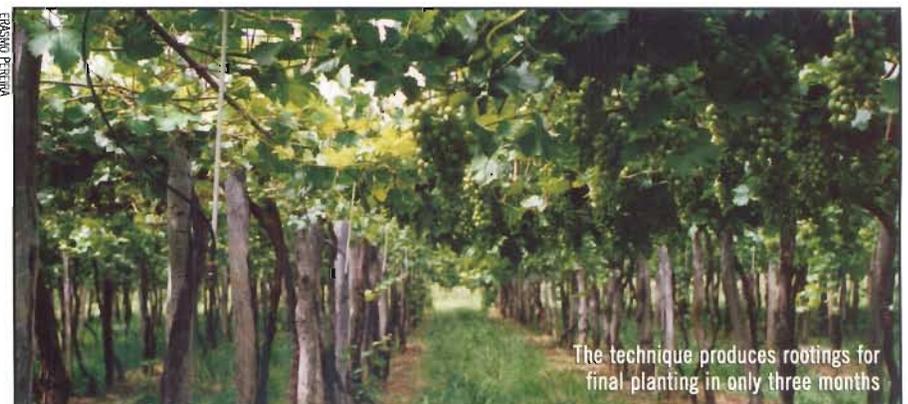
IPA began looking for a variety resistant to geminivirus and tospovirus in 1998. According to researcher Edinaldo Ferraz, the development of a new, highly productive, disease-resistant variety has helped increase not only the tomato production in the state (176,000 tons of industrial-quality tomatoes), but also the state's tax revenue (by close to US\$ 3 million). ■

## Epamig reduces time required to produce vine rootings

The Minas Gerais Agricultural Research Company (EPAMIG) has adapted a table grafting technique for grapevine that produces rootings for final planting in the field in only three months. Using resistant graft stock, the technique helps solve the difficulties arising from the emergence of *Phylloxera*, a vineyard soil pest.

The technique requires that the cuttings be labeled, packed in damp paper and stored in a cold storage chamber for 30 days. After this resting period, the cuttings

are hydrated and prepared for grafting, and then waxed and stored under controlled temperature and humidity conditions for another 30-day period, following which they are kept in the greenhouse for 30 days more, when they are ready for final planting. According to researcher Murillo Albuquerque Regina, the success rate was 80% in the essays, comparable to the results obtained in countries where this technique is used commercially. ■



The technique produces rootings for final planting in only three months

## Semen bank conserves fish species in the Pantanal

A research project is drawing the attention of scientists and environmentalist: the Frozen Semen Bank for Pantanal Fish. Researchers have already collected and frozen semen from the main commercial species in the region, such as pacu (*Piaractus mesopotamicus*), dourado (*Salminus maxillosus Valenciennes*), pintado (*Pseudoplatystoma corruscans*), and cachara (*Pseudoplatystoma fasciatum*).

A team coordinated by EMBRAPA Pantanal researcher Emiko Kawakami captured the fish in the Taquari and Miranda rivers. "We are ahead of schedule in the collection of the material and hope to contribute to the maintenance of the

genetic diversity of fish in the region, as well as provide assistance to fish-farming projects throughout the country." According to the researcher, the upper Paraguay basin is still one of the best-preserved watersheds in the country. There is a considerable bank of sexually mature fish and important populations of migrating species for commercial and sports fishing.

In addition to the Pantanal, there are similar operations in the states of Minas Gerais, in partnership with the Federal University of Minas Gerais, Catholic University (PUC Minas), Minas Gerais Electric Power Company, Furnas, and Eletrosul and Santa Catarina, with the Federal University of Santa Catarina (UFSC). ■



Pacu will also benefit from the Semen Bank

## Bedded swine housing system helps preserve the environment

Producing swine on bedding has had a major impact on swine waste management. This is one of EMBRAPA's most successful innovations in the company's history. The system eliminates liquid wastes and, consequently, prevents pollution, particularly of rivers and springs around the farm. "In addition to the environmental advantages, the bedding system requires a smaller initial investment and improves the well-being of the animals", guarantees researcher Paulo

Armando de Oliveira, from EMBRAPA Swine&Poultry.

Instead of a hard floor, the animals have a 50-cm layer of wood shavings, straw or rice husks. "I work much less with the bedding system and produce without any strong odors, flies and pollution", explains Valmir Gasperio, a farmer in Concórdia, State of Santa Catarina. It is estimated that more than 2,000 swine producers are using this technology in the country. ■

## Bioconversion Tank, a solution to basic sanitation

At Fazendinha Belo Horizonte, in Jaboticabal, State of São Paulo, the lack of basic sanitation is no longer a problem. A simple and inexpensive way of treating domestic sewage, discovered by EMBRAPA Agricultural Instrumentation researcher Antônio Pereira de Novaes, was found to stop pollution of the groundwater table and the wells.

The researcher deflected the pipes from the cesspool pit, very common in over four million farms in the country, to asbestos or polypropylene tanks, in which the night-soil and accompanying enteric bacilli are biologically converted into organic matter. This fertilizer is being used in soursop (*Annona muricata L.*) and macadamia groves and even the vegetable garden. The new system costs approximately R\$ 200 for a family of five and helps prevent diseases such as diarrhea, hepatitis and salmonellosis.

The system has been approved by several municipal departments of agriculture in the State of São Paulo and has strong support throughout the country. In São Carlos, the local government has plans to build at least 150 bioconversion tanks in the rural area and, near Campinas, the government of the Socorro municipality, 50 more. ■

The bioconversion tank is an alternative to eliminate contamination of the groundwater table



# Laboratory begins the Age of Functional Genomes at EMBRAPA

EMBRAPA's Functional Genome Laboratory began 2002 immersed in the sequencing of 100,000 genes of coffee, 60,000 genes of nematodes that infest soybean and more than 60,000 sequences of the *Crinipellis perniciosus* fungus, which causes the witches' broom disease in cocoa. And more to come, as demand increases. "We are taking on, in partnership with various organizations, the sequencing of eucalyptus (*Genoliptus* project); Musa, with the international banana consortium; and other projects in the field of animal health, whose purpose is to produce antigens against cattle ticks", explained researcher Luiz Antônio Barreto de Castro, head of EMBRAPA Genetic Resources & Biotechnology and technical coordinator of the project.

Other sequencing efforts are being negotiated with foreign funding agencies, such as the sequencing of peanuts, with European Union resources; cassava mutants; and a *Fusarium* species (fungus) that causes great losses to Brazilian agriculture. Three other projects could be started later this year, namely, the genomes of swine and rice and the sequencing of tomatoes linked to that of nematodes. The latter falls under the Functional Genome - Roots program, which seeks the functional characterization of genes expressed in the roots, associated with various forms of biotic stress (such as nematodes) and/or abiotic stress (such as draught and aluminum toxicity).

The laboratory is located in Brasília and performs the functional analysis of genomes on the basis of cDNA libraries, which are plates containing the functional

DNA of organisms amplified in cloned bacteria. The current laboratory capability is 1,000 sequences per day, but it could be doubled in 2002, if necessary. Dr. Barreto de Castro believes that the laboratory will have to be expanded in order to meet an increasing number of commitments.

... more work  
in view, since  
demand keeps  
on rising

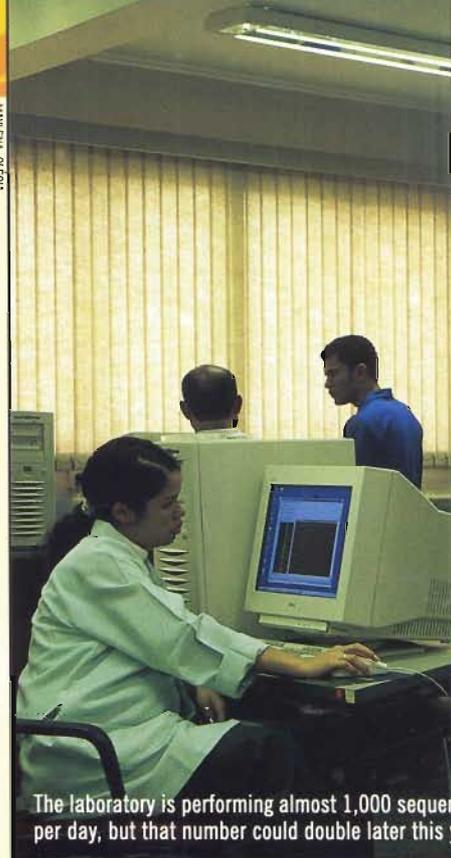
According to Dr. Barreto de Castro, the laboratory, which was opened at the end of 2001, is the final link required for integrating all genetic resources and biotechnology actions EMBRAPA has been developing for decades. "The only thing

missing was gene identification and sequencing, and now we have an instrument to scan our Gene Bank, one of the most complete gene banks in the tropical world, seeking solutions and making discoveries", celebrates Barreto. ■

## Functional Genome selected

EMBRAPA has decided to work with the functional genome in order to save time and resources. Luiz Antônio Barreto de Castro reveals, however, that the main reason is the possibility of focusing on specific agricultural problems and, at a later time, facilitating the application of the information to short-term breeding programs for plants, animals and microorganisms. Thus, EMBRAPA will decipher only the part of the gene important for Brazilian agriculture, instead of sequencing the whole DNA of a product or living being (Structural Genome).

MATEIA OLIVEIRA



The laboratory is performing almost 1,000 sequences per day, but that number could double later this year

## Preparations began in 1998

EMBRAPA assigned strategic importance to the Functional Genome - Roots project in 1998. The project team would work in a laboratory network coordinated by EMBRAPA Genetic Resources & Biotechnology, and other companies and EMBRAPA units would also participate. More than US\$ 1.5 million were invested in the purchase and installation of equipment for the Functional Genome Laboratory and another one-million dollars, in five sequencing machines for other EMBRAPA units, everything linked in a network. The resources were transferred by the Ministry of Agriculture and Supply of Brazil.

The research structure is made up of a sequencer capable of performing 1,000 sequences per day; a robotic system that executes thousands of replications per hour; eight machines to extract and prepare the sequences; one Micro-Arrey system to compare and analyze the sequences already performed; and ten supercomputers to store and help sequence the genes.



## Sugarcane and Leishmania will also be deciphered

The Pernambuco Agricultural Research Company (IPA) has also inaugurated a genome laboratory. The work will be initiated with the genetic sequencing of sugarcane and *Leishmania chagasi*, the causative agent of leishmaniasis. The study of the sugarcane genome is the continuation of work begun at FAPESP. According to researcher Angélica Montarroyos, the difference is the focus on details of the Northeast region, seeking new findings that could make sugarcane more profitable in the State of Pernambuco.

The decision to map the leishmaniasis parasite was based on an appeal of the public health authorities in the region - 90% of leishmaniasis cases occur in the Northeast region. The basic idea is to obtain as much genetic information as possible in order to provide input for research on a vaccine and new therapeutic products. Four years will be necessary to achieve the more practical results of the research. ■

## Consortium initiates genome research on coffee

The Brazilian Coffee Consortium (CBP&D/Café) coordinated by EMBRAPA Coffee, together with the São Paulo Research Funding Agency (FAPESP), is deciphering the genetic code of coffee through the sequencing of 50,000 genes. The research should be concluded late this year. The sequencing effort will focus on Arabica type coffee, which accounts for 70% of the national coffee production, although the genes of *Canephora* will also be investigated. The latter species is resistant to some



50,000 coffee genes to be sequenced

pests and diseases. One of the research objectives is to decipher the resistance of the plant to diseases, pests, cold, and draught, seeking means of reducing the production costs associated with pesticides by 50 to 100% and increasing productivity from 30 to 50%.

The functional analysis of the coffee genome can speed up breeding research by as much as 20 years, enabling the creation of new varieties, improving the quality of the beverage, increasing the market share with higher value added products, and maintaining Brazil's special position in world coffee growing. The

sequencing task will be divided between EMBRAPA and FAPESP's Agronomical and Environmental Genome (AEG) program, with intense participation of the Campinas State University (UNICAMP), São Paulo University (USP), Paulista State University (UNESP), Paraná Agronomy Institute (IAPAR), Federal University of Lavras (UFLA), Federal University of Viçosa (UFV), Campinas Agronomy Institute (IAC), Minas Gerais Agricultural Research Company (EPAMIG), and the Capixaba Institute for Research and Rural Extension (INCAPER). The total cost of the project is estimated at R\$ 6 million. ■

## UFPe joins the South Genome Project

The Federal University of Pelotas (UFPe) has joined the Southern Network for Genome Analysis of universities and research centers in the three states of the South Region of Brazil. The purpose of the network is to implement the South Genome Investigation Program (PIGS) in order to sequence bacteria that cause diseases in swine.

The first bacterium to have its genome sequenced will be *Mycoplasma hyopneumoniae*, the causative agent of *mycoplasma pneumonia* in swine. This first



The project will sequence the genome of bacteria that cause disease in swine

sequencing will be concluded by late 2002, to be followed by other equally important microorganisms, such as the etiological agents of meningitis and pleuropneumonia in swine. ■

## Brazil Seen from Space makes satellite images more accessible

The release of the Brazil Seen from Space collection, a package of mosaics of the states in Brazil, is rapidly becoming one of the most important initiatives for the democratization of what was previously the exclusive domain of researchers and government authorities: satellite images.

The collection has proven an important ally of NGOs, teachers, students, public agencies, and researchers, as noted by

Alejandro Dorado, Ph.D. in Environmental Management and coordinator of the ECOFORÇA NGO. "With these images we were able to draw up, in very little time, an environmental diagnosis of the Campinas region, where the NGO carries out specific work. And making these images available through the Internet represents great progress for students, who become familiar with resources that were previously quite separate from their reality", he emphasizes.

This innovative work was performed by EMBRAPA Satellite Monitoring researchers. The mosaics for each state are available at the site <http://www.cdbrasil.cnpm.embrapa.br> or can be purchased in CD ROM form. There is no need for specific software. ■



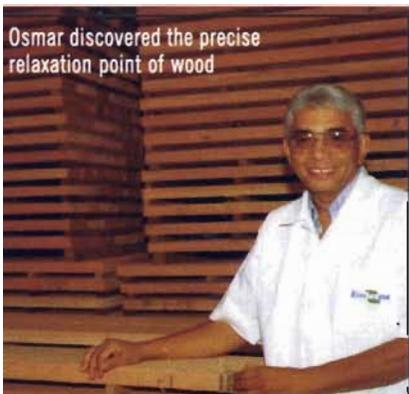
Morro do Diabo State Park in Pontal do Parapanema, São Paulo, surrounded by farms

## Technological revolution in the timber drying process

Technology developed by researcher Osmar Romeiro Aguiar at EMBRAPA Eastern Amazon is bringing about a revolution in the industrial timber drying process. The invention has been patented in Brazil and France by EMBRAPA and the National School of Rural

Engineering, Water and Forests (ENGFREF) in Nancy, respectively.

Osmar discovered the precise relaxation point of wood, where high temperatures can be used to dry the timber quickly, with very low defect rates. The new process has many advantages, with a major impact on the drying time, which can be reduced by 50%, and on warping and splitting, which drop from 10% to approximately 1%. In addition, it is possible to dry several species together, as opposed to the current system of drying species separately, and there is no need for pre-drying in the open air. Any kind of timber can be dried using the new method. ■



Osmar discovered the precise relaxation point of wood

## Transgenic orange variety is beginning to bear fruits

The first transgenic orange variety for commercial use is beginning to bear fruits in Brazil. Researchers of the Paraná Agronomy Institute (IAPAR), in Londrina, were the first in the country to transform a commercial orange variety using a bacteria-resistant gene in mature tissue, opening a new research field to obtain varieties resistant to *Xanthomonas axonopodis* pv. Citri, which causes citrus canker, one of the main limiting factors of orange groves in Brazil.

At the present time, the IAPAR team is carrying out

bacteria inoculation essays, whose results prove the resistance of the transgenic oranges to citrus canker. The next step is to clone the genetically modified plants, some of which are already producing fruits, in order to initiate the field experiments, in compliance with the biosecurity standards established by the National Committee on Biosecurity (CTNBio). The purpose is to check the effects of introducing the gene into the plant, as well as those related to food and environmental safety and security. ■

JONAS OLIVEIRA/CONRAB

Osmar Aguiar

## Four years of LABEX-USA

EMBRAPA is celebrating the fourth anniversary of its first laboratory abroad - LABEX. The first laboratory was set up in the United States following an agreement with the Agricultural Research Service (ARS) of the Department of Agriculture (USDA). LABEX-USA has carried out advanced studies in very important areas of world agribusiness, such as Food Safety.

"The joint work of Brazil and the United States, two countries complementary by nature, since they are located in different hemispheres, enables scientists of the two institutions to save time, since research initiated in the USA, which would normally be interrupted during winter, can continue in Brazil, where it is summer", stated LABEX-USA coordinator, Airdem Assis. As examples, he points to the results of the Precision Agriculture research, among the first partnership projects to be implemented, and those of an agreement involving the São Paulo Research Funding Agency (FAPESP) and the Grape Growers and Wine Producers

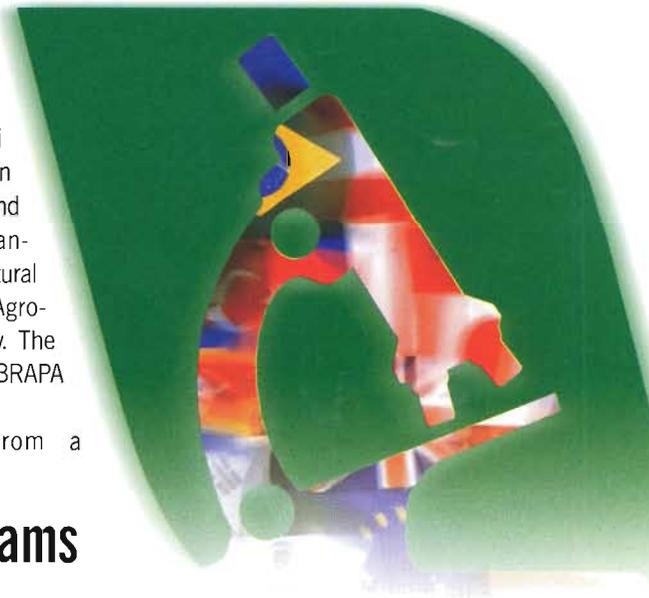
Foundation of the State of California to sequence *Xyllela fastidiosa*, the agent of Pierce's disease.

In the area of "Integrated Pest Management in Animals", LABEX-USA is ready to provide input on topics such as the "mad-cow" disease and to develop recommendations to prevent possible management problems in cattle production systems.

**France**—EMBRAPA has selected the first researchers who will work in its second laboratory abroad, located in France. The team includes Ana Cristina Miranda Brasileiro, José da Silva Madeira Netto and Regina Celi Araújo Lago, who will work in Advanced Biology, Technology and Knowledge for Sustainable Management and Conservation of Natural Resources and Foodstuff and Agro-industrial Technology, respectively. The coordinator of LABEX-France is EMBRAPA researcher Elísio Contini.

LABEX-France results from a

partnership between EMBRAPA and Agropolis, a science and technology center located in Montpellier. The purpose of the partnership is to strengthen cooperation between the two countries. LABEX-France will use the facilities of French research centers, following the LABEX-USA pattern. The contract contemplates exchanges with other European institutions.



## EMBRAPA maintains cooperation programs with more than 50 countries

EMBRAPA's international partnerships have attained a historical landmark this year. Today the company maintains cooperation agreements and activities with more than 150 institutions in more than 50 countries. "[People] are awakening to the presence of Brazil, since we play a very important role in and master tropical technology in the world", remarked Márcio Porto, head of EMBRAPA's Secretariat for International Cooperation.

The researcher explains that much of this interest began in the late 1990s and is due to Brazil's position between developed and developing countries. "Our characteristics, such climatic and soil conditions, are similar to those of the poorest countries in the world, but we also have agricultural technology as advanced as those developed in the first world", emphasizes Márcio Porto.

Not coincidentally, EMBRAPA is developing partnerships with 21 African countries and 23 nations in Latin America and the Caribbean. "In the last few years, we began

"opening" EMBRAPA to poorer countries to enable them to become acquainted with Brazilian technology and adapt it to their own reality", reminds us EMBRAPA President Alberto Duque Portugal. "For this reason, it is essential that developed countries continue to finance our research projects, helping to transfer new technology to the least developed countries", he concluded.

**Agreements**—Since its creation in 1973, EMBRAPA has received support from various international and foreign organizations, and expressive results have been transferred to Brazilian society. Today the company maintains 273 bilateral cooperation actions with 54 countries and 155 institutions. Special emphasis should be placed on the agreements with France and Japan, because of the many years of partnership and the results achieved. Multilateral cooperation actions, in turn, encompass 29 countries and 29 institutions, with stress on the cooperation with the Consultative Group on International

Agricultural Research (CGIAR), the regional cooperation programs coordinated by the Inter-American Institute for Cooperation on Agriculture (IICA) and the cooperation program with the United Nations Food and Agriculture Organization (FAO). In terms of financial cooperation, EMBRAPA has intense interaction with the Inter-American Development Bank (IDB) and the World Bank, as well as other public and private institutions.

EMBRAPA also participates in the Forum of the Americas for Agricultural Research and Development (FORAGRO), whose purpose is to help define a technology and agriculture research and development agenda and to provide input for the design of policies focusing on growth for the countries of the Hemisphere. The new chairman of FORAGRO for 2002 is EMBRAPA researcher and Director-President Alberto Duque Portugal, who will take office in Brasília, in April 2002.

## How research transformed urea into a cattle input in Brazil

Eighteen years ago EMBRAPA and PETROBRÁS signed a technical cooperation agreement to improve the efficiency of nitrogen use through the use of urea in cattle ranching in Brazil. At the time, most Brazilian ranchers did not favor the product. Not only was urea use in feedstuff unknown, but it was toxic.

PETROBRÁS produced the fertilizer industrially (a scarce product at the time) and funded the research. Many technologies were developed in the next 20 years, proving the strategic importance of urea in our country (see chart). EMBRAPA coordinated the research effort in which nine state research companies and four universities participated.

The results achieved can be seen everywhere. Today, a vast body of knowledge and information is available to producers, and the product can be easily found in the market, contributing

to the increase of domestic production. PETROBRÁS produces almost 3,000 tons of urea per month at its Laranjeiras (Sergipe) and Camaçari (Bahia) plants. The cattle herd loses less weight during the draught period, thus increasing productivity and profits for ranchers. Another success story is the use of urea in irrigation systems, particularly fruit crops in the semiarid region of the Northeast region.

There are more challenges for this successful partnership. In 2002, research will begin on the impact of urea use on plant and animal products, new mixtures (such as amíureia) and other fertilization techniques using irrigation, with a view to minimizing damage to the irrigation equipment. The idea is to seek alternatives in order to diminish production costs, increasing competitiveness and sustainability, as well as profits. ■



## Achievements:

### Cattle Urea

- Increased credibility of urea use in cattle operations (cattle urea)
- 300% consumption increase during the 1995-1999 period
- Consolidated the Multiple Mixture and Urea in Sugarcane systems
- Expanded PETROBRÁS cattle urea distribution network

### Urea Fertilizer

- Defining the dosage of PETROBRÁS' urea fertilizer in irrigated farming, such as fruit crops in the mid-São Francisco river region
- Improved techniques for using PETROBRÁS' urea fertilizer in irrigation
- Reduced wear of irrigation equipment as a result of the high purity and enhanced solubility of the urea fertilizer
- Increased share of urea fertilizer in fertilization formulas

### Next Steps

- New urea additives and fertilization management techniques to reduce urea fertilizer volatility in crops and pastures
- Equipment to incorporate urea into the soil in direct tilling systems
- Increased urea fertilizer diffusion in irrigation
- Use of cattle urea associated with agricultural and agroindustrial residues/by-products
- Influence and effects of formaldehyde and PVA (a chemical component) as urea additives in animal nutrition.
- Increased diffusion of cattle urea in multiple mixtures, sugarcane, mineral salt, etc.



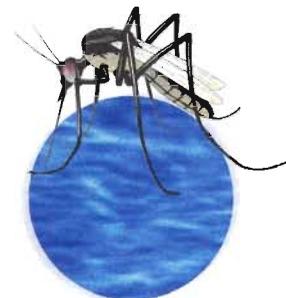
## Carpet reduces weeds in coffee plantations

EPAMIG research shows that a carpet made of recycled material can solve weed problems in coffee plantations, doing away with insecticides and weeding. Made of recycled paper, the carpet is permeable to water and nutrients and prevents weeds from germinating. Bactericidal substances delay its decomposition.

Placed in the coffee rows, the carpet promotes the development of plants because it helps retain soil humidity, lessening evaporation, as compared with unprotected soil. Researchers Elifas Nunes de Alcântara and Edson Marques da Silva are now evaluating the economic impact of the carpet for farmers. ■

# Bioinsecticides combat dengue mosquitoes

The fight against *Aedes aegypti*, the mosquito that transmits dengue fever, has been reinforced. Two biological insecticides developed by different Brazilian agricultural research companies have shown high efficiency rates against *A. aegypti* larvae, while being safe for the environment and the population. The research was carried out at different times and for different purposes, but the resulting products can help control the disease.



## IPA successfully tests biological insecticide

The Pernambuco Agricultural Research Company (IPA) has successfully developed a biological insecticide against *Aedes aegypti* larvae. The first batch of the product, which comes in the form of granules and tablets and has no commercial name yet, was produced in early March. IPA scientists have



QUANILDO PEREIRA LEAO

IPA produced the first vaccine lot in March

demonstrated the efficacy of the *Bacillus thuringiensis israelensis* (BTI) larvicide. The idea is to eliminate larvae before they reach adulthood, when they attack people.

According to researcher Liane Maranhão, IPA has submitted a project to the National Health Foundation (FUNASA) for manufacturing BTI in industrial scale. The project is estimated at R\$ 2 million for a production of 960,000 biolarvicide tablets per week. The product was jointly developed by IPA and the Antibiotic Department of the Federal University of Pernambuco (UFPE), the Aggeu Magalhães Research Center and LAFEPE. Its potential larvicide effect is 100% up to 48 hours after application ■

## Embrapa began research in 1988

EMBRAPA Genetic Resources & Biotechnology's search for an insecticide against the dengue mosquito vector evolved from experiments in agricultural pest control. The initial work began in 1988 with the use of *Bacillus thuringiensis* (Bt) for the biological control of urban pests, such as the *Culex quinquefasciatus* mosquitoes and other insects. The studies also detected the effectiveness of this bacteria against *Aedes aegypti*.

According to researcher Rose Gomes Monnerat, who leads the project, the product was first produced in the early 1990s, in partnership with a company licensed by EMBRAPA. It was commercially tested at the municipal level, with very good results. After further research, Bthek, a company located in Brasília, is being licensed to produce the bioinsecticides; one against *Aedes* and the other against *Culex* and *Anopheles* mosquitoes, which transmit malaria. Both products can kill 100% of larvae in up to 48 hours after application. Production is scheduled for the second half of 2002.

# EMBRAPA and UFSM develop vaccine against *Phythium insidiosum*

An experiment using the Pitium Vac vaccine is curing 50 to 80% of *Phythium insidiosum* infections in horses. As a rule, the disease requires surgery, which is often difficult to perform because of the location and extension of the lesions. *Phythium insidiosum* infections kill 100% of affected animals. The vaccine was jointly developed by EMBRAPA and the University of Santa Maria (UFSM) and its commercial release is scheduled for later this year.

*Phythium insidiosum* in-

fections are common in the Pantanal region of Brazil, but cases have been recorded in other

states. The disease affects horses, dogs, cattle, cats, and humans in tropical, subtropical and temperate areas. The research has been funded since 1998 by the project "Support to the Development of Agricultural Technology for Brazil", also known as PRODETAB, with partial funding from the World Bank.

Since the vaccine comes as a powder and does not require refrigeration, it is easily transported and stored. It is also easy to apply. ■



GEORGE CARVALHO

## Fruit fly control biofactory in Brazil

Juazeiro, in the State of Bahia, will be the site of the first biofactory in Brazil, where sterile fruit flies (*Ceratitis capitata*) will be produced for the purpose of controlling one of the worst fruit pests in the world. Juazeiro and Petrolina, the latter in the State of Pernambuco, make up the most important fruit export center in the Northeast region of Brazil and produce 926,591 tons of fruit p.a. in an area of almost 50,000 hectares. EMBRAPA Cassava&Fruits will provide technological support to the biofactory.

The underlying idea in generating sterile fruit flies is diminishing the amount and frequency of insecticide application, protecting the environment and growing fresh fruit according to rigorous food safety standards. The scientific basis of the



The biofactory will produce sterile male fruit flies

research is the fact that female fruit flies only copulate once in their lifetime. "A female fruit fly that copulates with a sterile male does not produce any progeny", explains Antônio Nascimento, one of the researchers at EMBRAPA Cassava&Fruits in

charge of the project. Fruit fly control based on this technology requires releasing into the environment a larger proportion of sterile insects than the existing wild population.

The investment in the biofactory is estimated at US\$ 3.5 million. According to the technical staff of the International Atomic Energy Agency (IAEA), one of EMBRAPA's partners in the undertaking, the first lots of sterile males will be released in two years. Initially, the biofactory will produce 200 million sterile *C. capitata* males per week. The facilities in Juazeiro will help Brazil match the competitiveness of countries like Argentina, Chile, Guatemala, Mexico, the United States, Portugal, South Africa, and Thailand, where such biofactories already operate. ■

## Innovative seed-drying system

In order to control humidity and adequately store seeds, most of the Brazilian soybean production is dried. EMBRAPA and the University of Florida (USA) have developed an innovative seed-drying system based on NASA technology. "The main characteristics are high efficiency, because of the low operational cost, and high effectiveness, as shown in the excellent results achieved", says researcher Francisco Carlos Krzyzanowski, from EMBRAPA Soybean.

The traditional system is restrictive, since it uses air heated at a high temperature not in excess of 40°C, in order to avoid the risks of reducing germination and seed vigor. The new technology, known as Heat Pipe Technology (HPT), uses dehydrated air and room temperature for drying the seeds, thus diminishing considerably any negative effects on the physical and physiological qualities of the seed. HPT use depends only on the replacement of the source of heated air by the new air treatment system. The industrial test in Brazil will be carried out in the next few months. ■

### On-going research:

## Using sludge as fertilizer in coffee plantations

The Agronomic Institute (IAC-APTA) began last February at the Santa Elisa Farm in Campinas, State of São Paulo, research on the use of sludge as fertilizer in coffee plantations. Using sludge in agriculture will not only contribute to the preservation of the environment, but also help farmers save with inputs. The costs of the essays are estimated at R\$ 15,000, which are being financed by the Brazilian

Coffee Consortium (CBP&D/Café), coordinated by EMBRAPA.

"Using sludge in agriculture is the best alternative method of disposal of the product, since it prevents pollution. Being organic matter, it also contributes to improve the soil", says Ronaldo Berton, from the IAC Soil and Agro-environmental Resources Center. The first results of the study will be available in two years. ■



Using sludge saves farmers money and preserves the environment

## Electronic Tongue beats human taste buds

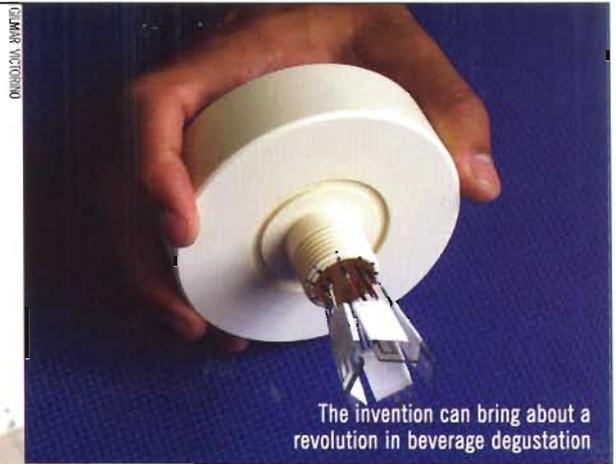
The famous Brazilian "cafezinho" that seduces all peoples, secular wines of countless flavors and precious water can now be analyzed by a palm-size device called the Electronic Tongue, an invention of EMBRAPA Agricultural Instrumentation that promises a revolution in degustation methods.

"This novelty will shake the sector, but will not endanger the jobs of professional beverage degustators", notes researcher Luiz Henrique Capparelli Mattoso, coordinator of the project that led to the cybertongue. He believes the invention represents progress in quality control, because it makes testing the flavor of

coffee, milk and other beverages, as well as assessing the quality of water, a speedier, more precise, and low cost process.

Cooxupé, the largest coffee cooperative in the world, located in southern Minas Gerais, Brazil, exports more than one million bags of coffee per year and tests the flavor of more than 2,500 cups of coffee per day during the harvest season. Nelson Almera Coelho, one of Cooxupé's four degustators, notes that "three consecutive errors in the evaluation of an export load of coffee can bring about

the bankruptcy of a company". He believes that the Electronic Tongue will be an indispensable tool in the sensorial evaluation of coffee and other beverages. The company is interested in using this innovative equipment.



The invention can bring about a revolution in beverage degustation

## BRS Eliza changes the potato market

A potato with sufficiently strong agronomic and commercial characteristics to compete with the imported product can already be planted in different regions of Brazil. EMBRAPA Temperate Agriculture has released BRS Eliza, a potato variety appropriate for the retail market, with excellent tubercle appearance and high pest resistance. For farmers, BRS-Eliza lowers production costs. For housewives, the new product is good for making mashed potatoes and using in salads

Ten thousand of the 30,000 potato producers in Brazil will benefit by planting Eliza. Its resistance to early blight and potato Irish famine (late blight), the worst potato leaf diseases, cuts substantially the number of fungicide applications on the aerial part of the plant. Farmers usually apply fungicides 10-30 times during the season, while Eliza requires 50% fewer applications.

Considering that 3,900 tons



The new potato can compete with imported varieties

of seed-potatoes are imported every year, totaling R\$ 7 million and involving 500,000 people, the characteristics of BRS Eliza will probably seduce potato farmers. Its production potential exceeds 50 tons per hectare; its white peel, smooth pellicle and light yellow meat equal the best imported varieties. Researcher Arione Pereira says that BRS Eliza is the only variety able to compete with Monalisa, for example, the imported variety most frequently planted in Brazil, which occupies about 50% of the potato farming area in the country. BRS Eliza was validated in farms located in several states and was first sold during the last harvest (July). Seeds will be available to farmers for next year's planting. ■

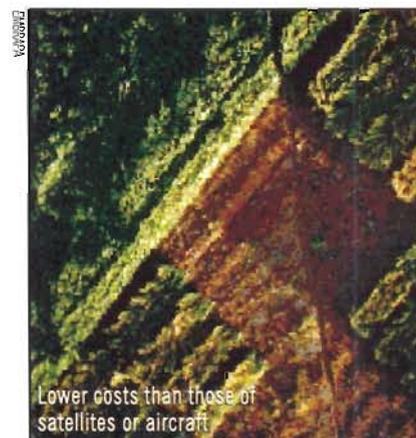
## Model aircraft substitutes satellite in gathering aerial images

Tasks previously performed by satellites are now being done by a low-cost, more flexible device - a model aircraft. The prototype, which could launch a revolution in the rural areas of Brazil, was developed at EMBRAPA Agricultural Instrumentation, in partnership with the Institute of Mathematics and Computer Science of the University of the State of São Paulo at São Carlos.

Equipped with cameras and transmitters that send information to a computer on the ground, the model aircraft facilitates topographic surveys, detailed mapping of farms and crop-status assessment. It identifies areas subject to erosion, pests and other problems. The system is also useful in managing direct tilling fields, where it is important to determine the dry-matter cover over the soil.

The use of model aircraft has

a series of advantages over satellites and conventional aircraft, including much lower costs and greater operational flexibility in terms of speed and altitude. The big difference, however, is the advanced technology used in processing and analyzing aggregated images adapted by EMBRAPA, which enables precise and speedy diagnoses. The model aircraft is already being used in research projects and has awoken the interest of geoprocessing companies. ■



Lower costs than those of satellites or aircraft

# Agribusiness, Sc&T and Development

Forty years ago, Brazilian agribusiness was based on a few sectors focusing on exports, such as coffee and sugarcane, as well as the production of grain and cattle, which supplied the domestic market. In the 1960s, the political and economic scenario of the country did not allow for significant progress. Not being pressured into modernization, companies had little demand for technology.

The second half of the 1970s and the whole 1980 decade was marked by a huge effort to modernize agriculture, not only traditional farming, animal production and extractive activities, but also the development of modern agriculture in the Cerrado, tropical semiarid and part of the Amazon region. Production chains became better organized and able to specify and qualify the technology demands for the country's innovation system. The period was characterized by great progress in Sc&T methods and tools and a comprehensive and a successful graduate studies program for researchers in the field of agronomy and related subjects, which was followed by an overall review and modernization of research methods and the creation of several centers of excellence. The new agricultural research capability developed broader approaches to technology problems, increasing the pace of technological innovation in the country and bringing about significant changes in the competitiveness of Brazilian agribusiness.

From 1970 to the late 1990s, Brazil more than doubled grain production, with only a minimum increase (38%) in the farmed area. Few countries in the world have had such productivity increase in such a short period of time. And we went even further. We conquered the Cerrado region with commercial agricultural operations; generated significant environmental gains using biological control techniques against pests and diseases and inoculating soybean with nitrogen

fixation bacteria; and improved the performance of our cattle through advanced techniques of artificial insemination, embryo manipulation, animal husbandry, breeding, and nutrition. We perfected our harvest plans through agricultural zoning for various crops; set up fruit orchards in the Northeast region of the country, transforming the region into an important export center; recuperated and expanded cotton farming; introduced sustainable agriculture in the Northern region based on agroforestry techniques; began rational logging through appropriate forest management, etc. And we seldom measure the results of these achievements.

At EMBRAPA's request, economists Regis Bonelli, José Roberto Mendonça de Barros and Juarez Rizzieri recently carried out comprehensive studies on the impacts of the technological changes in Brazilian agriculture on the Brazilian economy. The outcomes of these studies show that agricultural growth was a decisive factor of social inclusion for a considerable part of the Brazilian population and, indeed, precedes and determines the growth of the industrial and services sectors. In addition, the enhanced organization of Brazilian agribusiness resulted in a real 5.25% drop in the prices of basic foodstuffs during the 1975-2000 period.

The indisputable element underscoring this invisible revolution, as described by Regis Bonelli, is agricultural research. Technology has made it possible to increase agricultural productivity, generating income and creating jobs. It has eliminated seasonality, diminished production costs and enriched the diet of the Brazilian people. It has altered the geography of agriculture, taking development to the hinterlands. And there is more: technology has significantly increased the competitiveness of the agricultural sector, causing an expressive rise in exports (3.13% p.a.) and a decrease in imports.

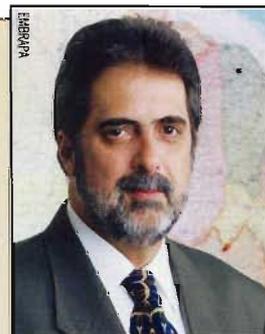
Researching is also looking towards the future. It is a promising future, fraught with challenges, where the scientific programs of our institutions will continue to be guided

by major national themes, as well as the demands coming from our economic and social order. Strategic areas such as biotechnology, genetic engineering, precision agriculture, environmental impact, information science, and food processing, which improve the health, nutritional status and standards of living of our population, will continue to be top priority. This huge research effort will continue to take into account factors such as environmental sustainability and social equity. And, in the rural areas, this means the inclusion of small farmers into the development process.

A fundamental tool in meeting this enormous challenge has been, and will continue to be, the partnerships established between institutions such as EMBRAPA, the universities and state research companies. Equally important will be the partnerships of those institutions with international and foreign research organizations and the private sector, especially the technical assistance and rural extension services, which take the technology generated to the farmers. A huge network that has demonstrated, year after year, its strategic importance for the development of the country - a network that should be continuously stimulated, definitely strengthened and permanently valued.

The Federal Government is fully aware of the importance of Sc&T. It has been investing in Sc&T research and, in particular, has assigned it an important place in the political agenda. Agribusiness, as we have seen, has responded positively to the sectoral policies. It has become increasingly modern, gained a new dimension and driven the creation of new "civilizations" in the hinterland, thus contributing to the equilibrium of the balance of payments and truly transforming our country.

**Alberto Duque Portugal** is a researcher and Director-President of EMBRAPA.



# COOPERATION BRINGS ABOUT A BETTER FUTURE



The Brazilian Agricultural Research Corporation (Embrapa) maintains cooperation and exchange agreements with more than 150 research institutions, in 50 countries, in all continents, covering the most diverse areas of agricultural activity. As both provider and beneficiary of the projects, Embrapa works to make agricultural techniques and knowledge increasingly agile, comprehensive and effective, while preserving the environment. Embrapa reiterates, day after day, its commitment in transforming information into products and services that improve the quality of life of the Brazilian people.

MINISTRY OF AGRICULTURE,  
LIVESTOCK AND FOOD SUPPLY

**Embrapa**

Brazilian Agricultural Research Corporation

**BRAZILIAN  
GOVERNMENT**