

AGRONOMY

Among the best in the world

Dinorah Ereno

Cultivation in vitro of eucalyptus
seedlings at the biotechnology laboratory

**ESALQ comes in fifth
in international ranking of
agricultural sciences institutions**

Founded thanks to the inspiration and determination of Luiz Vicente de Souza Queiroz, who donated the São João da Montanha plantation to the State of São Paulo in 1892 for the establishment of an agricultural school—officially inaugurated on June 3, 1901—the Luiz de Queiroz College of Agriculture (ESALQ) was classified, in November 2014, as one of the five best schools in the world in the field of agricultural sciences by the publisher U.S. News and World Report. Ahead of ESALQ were Wageningen University and Research Center in the Netherlands, the University of California, Davis and Cornell University in the United States, and the University of Agriculture in China. The factors that contributed to its classification are its global and regional reputation, number of publications and citations,

and international collaborations. On the 3,825-hectare campus, which accommodates 250 professors, 550 employees and more than 3,000 undergraduate and graduate students, towering trees and centuries-old buildings send you back in time. With more than 13,900 graduates, it is the first Brazilian institution of higher learning to have graduated more than 11,000 agronomists.

The activities and research carried out at the university have worldwide repercussions. “Some months, we receive up to 35 groups visiting from foreign academic and research institutions who want to see our work and learn from what we do here,” says Professor Carlos Eduardo Cerri, president of the ESALQ Research Committee and a specialist in environmental sciences.

“We receive invitations to take part in cooperation agreements all the time.” Some lines of research being developed now began in the 1980s. They are historical assessment series, such as studies of soil, vegetation and water carbon balance. In the terrestrial biosphere, carbon can be fixed in soil, in water, and in the gaseous form, when it becomes an environmental problem because greenhouse gases, such as carbon dioxide, methane and nitrous oxide, contain carbon and nitrogen and can cause climate change. On the other hand, activities such as agriculture, forestry and livestock raising have the ability to remove carbon from the atmosphere. “There are many factors that affect this balance and we need to establish standards to try and help improve it, in order to sequester more carbon from the atmosphere and emit less gas,” says Cerri. Experiments that evaluate the storage and release of carbon in soil, vegetation and water are carried out in different regions of Brazil. “I believe that ESALQ’s contribution is very important because, based on research done in the past, other institutions are also showing interest in the subject.” The introduction and adaptation of breeds of animals for milk, meat and eggs was

Institution pioneered the use of natural enemies to control pests

also an important ESALQ contribution to Brazilian agribusiness. Biological control, which uses natural enemies to reduce pest infestations in crops, is another line of research in which the institution has made important contributions, due to its pioneering spirit and excellent results. “The Department of Entomology and Acarology is known for its work in this area,” says Professor José Roberto Postali Parra, former dean of the institution and head of the biological control laboratory, which is part of the department. “In the 1940s and 1950s, Professor Domingos Gallo began working with Brazilian flies that are a parasite of the sugarcane borer (*Diatraea saccharalis*) in order to combat this pest in sugarcane fields,” he recounts. “He created biological control culture and we have expanded on his work.” At the time, pest control was done by hand, with the flies released in the field.

Parra’s group developed an artificial diet in order to breed the insect in the laboratory and also found other natural enemies of sugarcane pests and imported them. In the 1980s, he began to work with *Cotesia flavipes*, a wasp that is a larval parasite of the borer. “Today,

more than 3,300,000 hectares of fields throughout Brazil are controlled with this little wasp imported from Trinidad and Tobago in 1971,” says Parra. Another line of research begun by Parra with the parasitic wasp of the genus *Trichogramma*, also in the 1980s, resulted in the release of *T. galloi* on the market by the company Bug Agentes Biológicos, in Piracicaba. The insect was named in honor of Gallo’s pioneering spirit.

In 2012, a startup founded in 2001 by ESALQ graduate students was chosen as one of the 50 most innovative companies in the world by the technology magazine *Fast Company*. *T. galloi* is a different type of parasite, because the wasp attacks the eggs of the sugarcane borer, inoculating them with its own eggs and preventing the insect from hatching and attacking the plant in its caterpillar stage. The company’s innovation was to develop an efficient and economically viable method for breeding *T. galloi*.

Sugarcane is also the focus of research led by Professor Helaine Carrer in the biotechnology laboratory. She is also coordinator of the ESALQ International Graduate Program in Plant Cellular and Molecular Biology. “With genetic engineering, we can alter the metabolic pathways of plants and produce new plants with different characteristics,” she stresses. One of the studies performed in the laboratory resulted in a genetically modified plant more tolerant of water stress than the varieties used currently.



ESALQ students in class studying agricultural pests such as that of the cotton plant

“It survived a total lack of water for two weeks longer than commercial varieties, a significant result,” says Carrer, who participates in the FAPESP Bioenergy Research Program (BIOEN). Genetically modified plants are currently being tested in greenhouses.

To achieve resistance to water stress, the researchers used genes from the *Ara-bidopsis* plant. The introduction of new genes in plants is done with the aid of the bacterium *Agrobacterium tumefaciens*, found in the soil. In nature, the plant uses this device to produce compounds of interest. “Since this bacterium does not have much affinity with plants like sugarcane, wheat and rice, we can use another strategy to introduce genes into their cells,” she explains. A physical process could be used to accomplish this task. DNA fragments wrapped in gold particles can be introduced into the cells of the sugarcane plant quickly and, thus, become part of the plant’s genome. The plants obtained in this way have a new gene.

“Biotechnology, an important ESALQ field, has contributed to the development of agriculture,” stresses Carrer. “It is a new method that adds value to classical genetic improvement.” At the institution, about 20 laboratories work with biotechnology, on genetic studies, the interaction between plants and insects, microorganisms, the formation of fibers in plants, resistance to disease, water stress and the biochemistry of compound formation. The indicators for agricultural commodity prices, a market reference, are the result of daily surveys

conducted by the Center for Advanced Studies in Applied Economics (CEPEA), part of the Department of Economics, Business Administration and Sociology, on the principal supply chains for agricultural raw materials and their derivatives.

ESALQ has seven undergraduate programs—business administration, biological sciences, food sciences, economics, agronomy, forest engineering and environmental management—and 16 graduate programs, with the graduate degree in bioenergy being a joint program offered by USP, São Paulo State University (Unesp) and the University of Campinas (Unicamp). “A recent development, the first graduate program offered by the three universities together is an innovative approach in the state of São Paulo,” says Cerri. Since USP was chosen to be the host university, ESALQ is responsible for the program. ESALQ is also home to the International Graduate Program together with Rutgers University in New Jersey and Ohio State University. Cerri stresses that, of the 16 graduate programs, most have received the highest Capes scores, 6 or 7 out of 7, meaning that they are considered to be excellent. Among them are the graduate programs in entomology, genetics and plant improvement, animal science and pasture and soils and plant nutrition, with scores of 7 out of 7. “We are proud of these scores, the result of achievements over many years.”

A pioneer in the implementation of graduate programs at USP, ESALQ started its courses on September 15, 1964, in



Diaphorina citri, an insect that attacks orange groves and causes the disease called greening

the areas of experimentation and statistics; plant pathology; genetics and plant improvement; mechanics, engines and agricultural machinery; plant nutrition; and soils. Since 1966, when the first master’s thesis was defended, more than 5,500 master’s degrees and 2,700 PhD degrees have been awarded. “ESALQ has some peculiarities that make it similar to institutions in developed countries like the United States, such as the donation of large areas of land by former students for research,” says Parra. For example, one of the plantations donated in the city of Londrina, Paraná State, has 4,840 hectares and 6,000 heads of cattle. Another area, near the campus, has 20 hectares preserved with native species. “It was donated with the stipulation that it be used for research by students of environmental management,” he says.

The results obtained in a series of studies conducted at the institution are used for public policy decision making. “Some federal government programs were established based on the results of master’s theses, doctoral dissertations and publications that were produced here at the institution, mostly supported by FAPESP,” says Cerri. One is the Program for the Reduction of Greenhouse Gas Emissions in Agriculture—or the ABC Program, aimed at farmers. “We also took part in the definition of FAPESP programs, such as those for Research on Global Climate Change, Biota and BIOEN.” ■



Cotesia flavipes parasite of the sugarcane borer