

# The Application of Nuclear Science to Agriculture at Piracicaba

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by Carl G. Lamm

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**Agricultural production has high priority in Brazil and assurance of an efficient agricultural industry is of evident importance to the national economy. The establishment of CENTRO DE ENERGIA NUCLEAR NA AGRICULTURA (CENA) demonstrated the Government's intention to make use of modern technology in this effort.**

Piracicaba is a small town some 160 km west of the city of São Paulo. It is located in an agriculturally fertile region where sugar cane and citrus are among the predominant crops. Piracicaba is the oldest centre for agricultural education and research in Brazil, and Escola Superior de Agricultura Luiz de Queiroz (ESALQ), the agricultural college of the University of São Paulo, is found here, with traditions dating back to the last century.

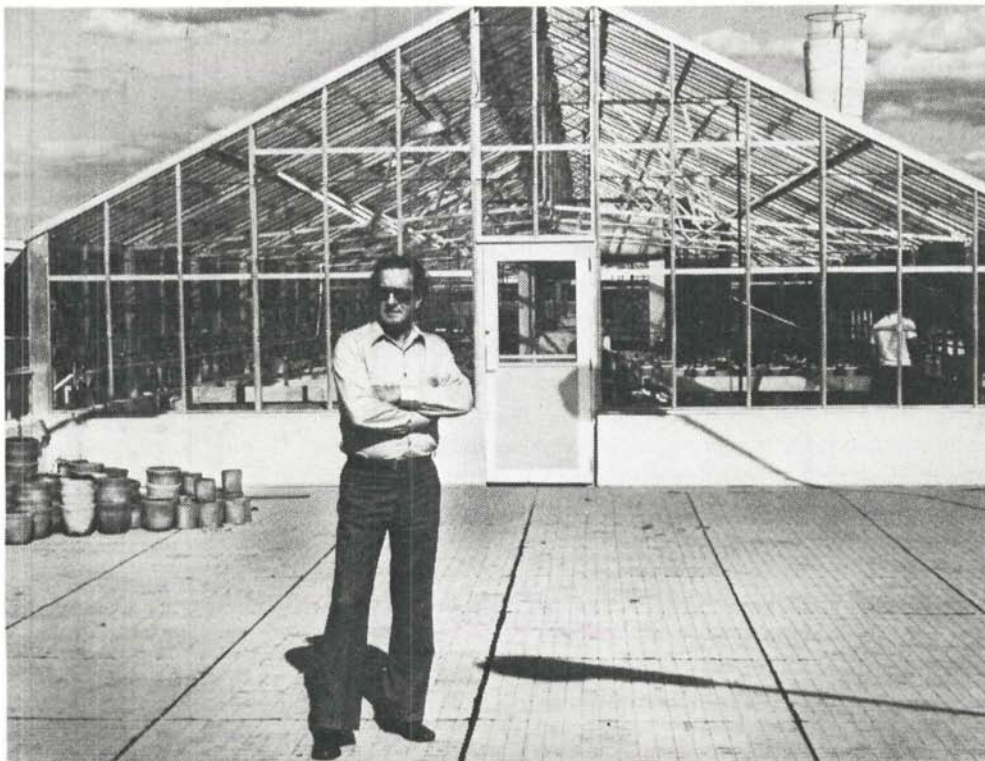
About 10 years ago, the Centro de Energia Nuclear na Agricultura (CENA) was set up to the ESALQ campus as a joint enterprise between the National Nuclear Energy Commission (CNEN) and the University of São Paulo.

Headed by Professor A. Cervellini, CENA has a professional staff of approximately 25 scientists in various fields of agriculture. The centre offers courses on the application of the nuclear sciences to agriculture at both undergraduate and graduate levels, and, as well, carries out research in a variety of agricultural disciplines. The research complements other conventional agricultural investigations and is carried out mainly in collaboration with ESALQ, but also with other state or federal agricultural research laboratories. In addition to its agricultural activities, CENA also conducts studies in isotope hydrology.

A five-year large-scale UNDP project, executed by the IAEA, was signed in 1972 with the objective of strengthening the existing training and research facilities and activities at CENA for the development of agricultural production through the application of nuclear technology. Presently, the UNDP contribution is estimated at \$1.26 million over the five years, with provision for approximately 200 man-months of international experts, over 200 man-months of fellowships, as well as for the purchase of equipment and laboratory supplies.

Recently, the Danish Government through DANIDA supplemented the CENA project by providing an expert in isotopes applied to environmental chemistry, 12 man-months of fellowships and funds for supplies.

CENA's research activities are organized under five divisions with a total of 16 sections: **Plant Sciences Division** — Plant Biochemistry, Entomology, Plant Pathology, Plant Nutrition, Plant Breeding; **Soil Sciences Division** — Soil Fertility, Soil Physics, Soil Microbiology, Soil Chemistry; **Animal Sciences Division** — Animal Nutrition, Animal Health; **Environmental Sciences Division** — Hydrology, Production of Stable Isotopes; **Basic Support Sciences Division** — Radiological Health Protection, Radio- and Analytic Chemistry, Instrumentation.



Dr. Cervellini, director of Centro de Energia Nuclear na Agricultura (CENA), in front of a greenhouse on the campus at Piracicaba.

Some questions are relevant in evaluating the impact of an institute like CENA and its project on the agricultural production of its country. How can efforts be directed towards helping to solve *problems of immediate economic and practical importance rather than satisfying only academic goals*? And how can it be assured that any practical achievements or results really reach the farmers for implementation on their land rather than ending up as a technical publication? The answers are, of course, to be found in the organizational set-up and in the infrastructure of agricultural training, research and extension within the country. Equally important is the devotion, knowledge and spirit of co-operation of the staff of the institute. In this respect the situation at CENA is virtually ideal. Through an intensive training programme, CENA is not only building up its own staff but also is able to train scientists from other research institutes in Brazil and, as well, from other countries. Support from the national authorities has been outstanding.

At CENA, an early decision was made to direct its efforts towards solving the problem of a decreased productivity of the common bean, *Phaseolus vulgaris*, which is the country's most important source of protein for human consumption. CENA's efforts are integrated in the National Bean Project under EMBRAPA, which ensures co-operation with all relevant research and extension work in Brazil. Co-operation is also extended to countries outside Brazil and to international institutes such as CIAT in Columbia. CENA staff also actively participates in several of the Joint FAO/IAEA Division's co-ordinated research programmes.

The achievements of CENA of immediate practical importance to bean production are in the fields of soil fertility, efficient use of fertilizers, mutation plant breeding for tolerance to the Golden Mosaic disease, and a better understanding of the symbiotic fixation of atmospheric nitrogen under the prevalent conditions. In isotope hydrology, studies to characterize the hydrological cycle and river waters in Amazonia through determination of stable isotope concentrations and investigation of the salinization of ground waters in the Brazilian North-East have been completed.

Studies on water balance in soils and the nitrogen cycle in bean crops are underway, as is work on characterizing the protein quality of various varieties of beans. Entomological activities have stressed ecological investigations of the sugar cane borer, *Diatraea saccharalis*, and a field experiment to assist the development of insecticide methods for its control have been carried out. Purification and electron microscope studies of the Golden Mosaic virus has provided a better understanding of this plant infestation. Studies with the stable isotope nitrogen-15 have provided the direct evidence of nitrogen fixation in tropical forage grasses. Pilot scale production of nitrogen-15 enriched material has been completed, demonstrating a potential daily production of six grammes of 5% enriched ammonium sulphate. Finally, CENA has now created — in close collaboration with the Technical University of Denmark — a central analytical laboratory, where various biological, soil and water samples are analysed at high rates and great precision. This laboratory is not only serving CENA's own requirements, but also offers its service to other laboratories. A possible project is the development of isotope applications to the economically important problem of animal nutrition and health.

CENA is the third institute in the world which has been established or strengthened through the catalytic effect of a large-scale UNDP project executed by the IAEA, and with the purpose of applying isotope and radiation techniques to increase agricultural production. The two previous projects were in Yugoslavia and India respectively, and a fourth project similar in nature, but funded by the Swedish Government through SIDA, is underway in Bangladesh. These institutes represent a happy marriage between national atomic energy commissions and agricultural research authorities. Although most of the basic research on the application of nuclear techniques in agriculture was carried out over 20 years ago, it is essential that these techniques be applied under the relevant climatic and soil conditions in order to solve local agricultural problems. Traditionally, courses on isotope applications are rarely included in the regular curricula for agricultural students, who must therefore obtain this additional experience through a specialized training, often in a foreign country. Furthermore, isotope equipment, facilities for radiological protection and radioactive waste disposal are usually unavailable in conventional agricultural research institutions. These institutes, in which atomic energy and agricultural authorities have pooled their efforts, have, on the whole, proven to be a successful means for extending the peaceful uses of nuclear energy to local agriculture in developing countries.