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Agro-Biotechnology in Portugal: the building up of a research center

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SUMMARY - The field of agro-biotechnology in Portugal has been traditionally supported by small size research groups, the links of which were not well defined. A self-sufficiency tradition is still to be found between scientists, their training tending to embrace all areas of agricultural research, using mainly conventional methodologies, which implies weak relationships with the fields of chemistry and microbiology. Although some uncoordinated and punctual efforts are made to improve these circumstances, the indispensable renewal of agriculture in Portugal will be achieved only by developing an adequate basis of skill that allows a solid knowledge and the technological support linked to the research structure. In order to achieve these objectives, the INIA (National Institute for Agricultural Research) and the INIC (National Institute for Scientific Research) have taken the decision to create a new Research Centre in Oeiras, in the Campus where some of the most important agricultural research units are located (National Agronomic Station - EAN) and near the Gulbenkian Institute of Science (IGC) which develops activities in the area of Basic Biology. The new Centre, CTQB (Centre for Technological Chemistry and Biology) will collaborate with existing organizations in the Oeiras Campus in specific programmes for research development, and will contribute, namely, to the promotion of traditional technologies and to devise solutions to maintain and improve products by means of the application of new technologies. The CTQB has launched its activities with 30 Ph.D's and approximately 80 graduates, covering the areas of Chemistry, Biochemistry, Biology and Plant Biology, Biochemical Engineering, Microbiology and Biocomputing, in facilities belonging to IGC and EAN. A new building (16000 m2) is being constructed. A non-profit association, IBET (Institute for Experimental and Technological Biology) has also been created, in order to link research with production. INIA and INIC, among others, are associated with IBET, as well as Portuguese industrial firms in the agro-industrial, agrochemistry, pharmaceutical and fine chemistry areas.

Key words: Agrobiotechnologies in Portugal - Research Centres in Portugal - Research organization in Portugal - Technology transfer.

RESUME - "Agro-Biotechnologie au Portugal : la création d'un centre de recherches". Le domaine de la recherche agricole au Portugal a été traditionnellement soutenu par l'existence de groupes de recherche de petites dimensions qui ont entre eux des liaisons plutôt floues. Il existe encore une tradition d'"auto-suffisance" chez les scientifiques, dont la formation aurait tendance à couvrir tous les domaines de la recherche agricole, en utilisant surtout des méthodologies classiques, ce qui implique que les liaisons avec les domaines de la chimie et de la microbiologie, sont rares. Bien qu'on puisse, bien sûr, constater des efforts, ponctuels et peu coordonnés, pour améliorer cette situation, l'indispensable rénovation de l'agriculture portugaise ne peut être menée à terme que si elle s'accompagne du développement d'une base de compétence adéquate qui permette un support solide de connaissances et de technologies, articulées à une structure de recherche. Ayant en vue ces objectifs, l'INIA (Institut National de la Recherche Agronomique) et l'INIC (Institut National de la Recherche Scientique) ont décidé de créer un nouveau Centre de Recherches, à Oeiras, sur le "Campus" où se situent déjà quelques unes des plus importantes unités de recherche agricole (l'EAN - Station Agronomique Nationale) et tout près de l'Institut Gulbenkian de Science (IGC) dont les activités se développent dans le domaine de la Biologie Fondamentale. Ce nouveau Centre, le CTQB (Centre de Technologie Chimique et Biologique) doit collaborer avec les structures déjà existantes dans le "Campus" d'Oeiras à des programmes concrets de développement de recherches, contribuant, nommément, à promouvoir l'utilisation de technologies traditionnelles et à établir des solutions qui puissent contribuer à maintenir et améliorer les caractéristiques des produits, en appliquant des technologies nouvelles. Le CTQB a commencé ses activités avec 30 Ph.D.'s et environ 80 étudiants universitaires, couvrant les domaines de la Chimie, Biochimie, Biologie et Biochimie Végétale, Génie Biochimique, Microbiologie et Bioinformatique, dans des installations empruntées à l'IGC et à l'EAN. Un nouvel édifice (16000 m2) est en train d'être construit. Une association privée à but non lucratif, l'IBET (Institut de Biologie Expérimentale et Technologique) a aussi été fondée, ayant comme but de faire l'interface entre la recherche et l'activité productive. L'INIA et INIC, entre autres, sont associés à l'IBET, de même que des entreprises industrielles portugaises dans les domaines de l'agro-industriel, de l'agro-chimique, pharmaceutique et de la chimie fine.

Mots-clés : *Agrobiotechnologies au Portugal - Centres de Recherche au Portugal - Organisation de la Recherche au Portugal - Transfert de technologie.*

The Portuguese agricultural research network has been based on small research teams, working with little coordination, using old equipment, and relying upon traditional methodologies in order to support agricultural, animal and forestry productions, as well as on outdated technologies for transformation of their products. A strong effort is being made to reactivate some of the research groups by an adequate reequipment and a gradual renovation of specialists, however there are some areas where there are at present difficulties in recruiting scientific personnel with the necessary qualifications. This requires strong and fast action. Among the areas which need a greater developmental effort are: Chemistry, Biochemistry, Microbiology, Enzyme and Fermentation Technologies, processes for recovery of biological products, as well as Biocomputing. These deficiencies have been minimized by resorting to research groups within the Universities and the Gulbenkian Institute of Science (IGC) but so far, this collaboration has only been occasional.

The situation described above is worsened by the perspective in which the problems are dealt with. Due to professional traditions, there is a tendency for Agricultural Engineers to try to cover all the areas related to agricultural research, for Veterinarians to cover all those of animal production, for Forestry Engineers to cover all those of forestry production, and, although the more heterogeneous sectors of Agro-food and Forestry technologies do receive some collaboration from Chemists and Microbiologists, this is done without an adequate integration. Thus, it is indispensable to promote the adaptation of the existing structures so that there will be a solid support for the improvement of the conditions of production, trading and transportation of agricultural products, an improvement of their industrialization, preservation and distribution periods, as well as of the food quality control.

The indispensable renovation of the Portuguese agriculture cannot be achieved without the development of an adequate interdisciplinary competence basis providing a solid support of knowledge and technology, and articulated to a research structure. The dependence of agro-industries on regional characteristics, the knowledge of which is fundamental in order to define the right priorities, to formulate the correct aims, and attain the desired goals, stresses the need of the development of such a support structure in Portugal. Indeed, it is indispensable that feasibility studies be carried out in this field to take into consideration: the availability of raw materials; the shortages (surplus) of agricultural products, the nutritional habits; and the local energy, environmental and import-export situations, with special attention to the constraints resulting from the recent adhesion of Portugal to the EEC.

In order to fulfil these objectives the INIA (National Institute for Agricultural Research) and the INIC (National Institute for Scientific Research) have decided to build a joint *Research Center* in Oeiras, within the same campus where there function the National Agronomic Station (EAN), the National Station for Agrarian Products Technologies (ENTPA), the National Center for Protection of Agricultural Products (CNPA, Pesticide Laboratory), and in the neighbourhood of the Gulbenkian Institute of Science (Sector of Fundamental Biology) and of one centre belonging to the Institute for Tropical Scientific Research (IICT), and where a unit for plant micropropagation is being built. The interdisciplinary research projects to be developed within this *Research Center* (Center for Technological Chemistry and Biology), include the areas of Chemistry, Biochemistry, Plant Cell Biology and Biochemistry, Biochemical Engineering, Microbiology and Biocomputing; the Center will also serve as a basis for establishing a culture collection of microorganisms and germplasm.

The activities of CTQB, in collaboration with the existing facilities at the Oeiras campus, focus on the following subject:

- to perform the characterization of agro-forestry raw materials, improving its technological use;
- to adequately characterize the collections of germplasm, whose potential for human and animal nutrition, as well as for industrial utilization, is scarcely known;
- to characterize, maintain and improve collections of microorganisms for agricultural, forestry and industrial uses; to detect and characterize substances which interfere with animal fertility, in pasture and forage plants, as well as in their preserved derivatives;
- to systematize the existing "know-how" on traditional technologies and to establish the basis for solutions which will allow to maintain and improve the product characteristics, when applying new technologies;
- to catalyze the transfer of technology to the agro-food and forestry sectors, taking into consideration the preparation of the field workers and the characteristics of the local raw materials, thus allowing an adequate introduction of technological innovations;
- to support the studies presently being developed in the Vine and Wine Research Centers, relating the quality of products and the environmental characteristics of the production region, namely for quality wines;
- to transfer to the agro-forestry and food industries the experience available in terms of

utilization of automatic data acquisition, particularly when using modern spectroscopic techniques;

- to organize chemical, biological and technological data banks, to perform process modelling and evaluate impacts;
- to potentiate the activities of the National Stations for the Technology of Agricultural Products and for Vine and Wine, rendering agriculture production more profitable by integral use or added value of the final products;
- to allow new technological utilizations, including non-nutritional ones, of the agricultural and forestry productions and at the same time to reduce their negative influence in the environment;
- the use of spontaneous biomass, namely that of marginal soils.

Finally, it will also allow the building up of a solid nucleus of qualified personnel which will enable the transfer of "know- how" from other countries.

Besides the applied research developed by the INIA staff, this Center will have the basic research support granted by a Sector with aprox. 50 Ph.D.'s in the areas of Biology, Chemistry and Engineering, financed by the National Institute of Scientific Research (INIC). This Sector will potentiate the applied research being carried out and will enable the development of the interdisciplinary projects aiming at a better relation between basic research and the productive sector, namely by creating pilot-scale facilities for general and specific studies. On the other hand it will also provide the critical means necessary to set up a training and post-graduation programme, which will foster the contact between future specialists with the research activity, and will secure a recruiting basis of specialists for Cooperatives, Small and Medium Enterprises as well as Regional Delegations of the Ministry of Agriculture. The collaboration of the future specialists with the research activities, during their training period as well as their presence in the laboratories, will create a strong link with the research teams, which will strengthen future relations between R&D and Production activities.

With the specific purpose of constituting an interface between Research and Productive activities, a non-profit private association, IBET (Institute for Experimental and Technological Biology) has been created. This institute is open to various forms of industrial cooperation, namely: training of technicians and researchers for industry; participation in research projects with industry under negociated formats and utilization of equipment and/or laboratories in joint projects or under confidentiality. INIC and INIA (and also the School of Biotechnology of the Catholic University (ESBUC), at Porto) are among IBET partners, as well as a set of industrial partners which includes the largest portuguese industrial firms within the fields of agroindustries and agrochemistry, pharmaceuticals and fine chemistry.

The CTQB is temporarily placed in a building belonging to IGC (2000 m2) and in the Department of Chemistry of the EAN (750 m2), where 30 Ph.D's and 80 graduate students are presently working. A new building is now under construction, on the site of EAN (16000 m2) and will be finished by 1992 (see Appendix). Next to the new building there will be a pilot plant (about 2000 m2) for fermentation, extraction and purification of natural and biotechnological products, and there is also some space reserved for launching new enterprise ventures.

Appendix

The new building will have 2000 m2/floor as the basic unit, with the following arrangement:

1. Technical area (Floor 1)
2. Common area (Floor 2)
3. Training laboratories (Floor 3)
4. Area for Research Laboratories (Floors 4 to 7)

Each unit of research laboratories (floor), includes the following space areas:

1. Laboratories - 670 m2 (48 %)
2. Support area (shared facilities) - 370 m2 (27 %)
3. Office rooms - 350 m2 (25 %)

and will be divided into 14 laboratories of 48 m2 each, each with 4 working positions of 2.40 m of bench, plus 1.20 for desk support and fume hoods and sinks corresponding to a maximum of 4.8 m of bench space.

The equipment includes:

- Central Computer
- Fermentation plant (fermenters of 2, 5, 10, 75, 300, 700 and 1500 litres, industrial centrifuges, ultra and microfilters, cell disrupters, GC, auto analysers and gas analysers for on-line computer control of fermentation).
- Ultracentrifuges, refrigerated and preparative centrifuges

- Spectroscopy equipment (NMR, EPR, MS, UV/visible, IR, CD and spectrofluorimeter).
- Chromatography equipment (columns and fraction collectors, HPLC, FPLC)
- Amino-acid analysers, polypeptide sequencer, potentiometer/polarograph, plasma emission and atomic absorption analysers, scintillation counters.
- Equipment for microscopy.
- Glove boxes, vertical laminar flux benches, biohazard benches, CO2 sterilizers, sterilization stoves, lyophilizers, autoclaves, ultra-cool freezers, orbital culture shakers,

most of which is already working in the temporary intallations.