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Strategies developed on biotechnology in agriculture in Greece

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SUMMARY - Biotechnology in Greece is planned and co-ordinated by the General Secretariat of Science and Technology (GSST); however, the Ministry of Agriculture has its own organization in this field, in co-operation with GSST. Among the tasks performed by both agencies the more relevant are the strengthening of the centres already existing, the funding of university research, the cooperation between laboratories, the creation of new centres, exchange of scientists... An overview of the research works of all four centres of the GSST, and of the six stations and institutes of the Ministry of Agriculture is presented. The research works of the major university laboratories are also analysed. Biotechnological applications in the public and private sector, as well as financial grants distribution, are discussed.

Key-words: Biotechnology in Greece - Disease control - In vitro culture - Micropropagation - Enzymes - Virus-free plant breeding.

RESUME - "Les stratégies biotechnologiques développées en Grèce dans le domaine de l'agriculture". En grèce, le Secrétariat Général des Sciences et de la Technologie (G.S.S.T.) planifie et coordonne les biotechnologies ; mais, en liaison avec lui, le Ministère de l'Agriculture possède, dans ce domaine, son organisation propre. Parmi les tâches de ces deux organismes, le renforcement des centres existants, l'attribution de fonds aux recherches universitaires, la coopération entre laboratoires, la création de nouveaux centres, les échanges de scientifiques... sont les plus notables. Un panorama des recherches des 4 centres relevant du GSST et des 6 stations et instituts du Ministère de l'Agriculture est présenté. Les travaux des principaux laboratoires universitaires sont également analysés. Les applications des biotechnologies dans les secteurs privé et public sont évalués ainsi que les répartitions des ressources financières.

Mots-clés : Biotechnologie en Grèce - Lutte contre les pathogènes - Cultures in vitro - Micropropagation - Enzymes - Sélection sanitaire.

Introduction

Biotechnology has been developed through advances in molecular biology, molecular genetics and other closely related disciplines of growth and development. Research on plant regeneration, cell and protoplast culture, somatic hybridization, disease elimination, recombinant DNA techniques or genetic engineering is very exciting for the scientist and undoubtedly important for progress in agriculture. Applications have resulted in high-quality agricultural products.

Acquisition of new knowledge should receive a major emphasis in order to continue to increase the efficiency of agricultural production and remain competitive. So, biotechnology should be encouraged to continue its advances by strengthening and funding research programmes closely related to the needs of a region or country. In recent years, public authorities in

each country which have become more aware of the role of biotechnology in the development of agriculture, have given a high priority to it, and have started to build a framework of the appropriate policy. In most cases policies on biotechnology in Member States of the European Community have much in common, and this is also true to some degree for other Mediterranean countries.

National policies and goals

In Greece the General Secretariat of Science and Technology (GSST) is primarily in charge of planning and coordinating the policy on biotechnology. The Ministry of Agriculture also has its own policy on biotechnology which, however, is cooperative with that of GSST for the common benefit.

Biotechnology has received major attention and has been given high priority in the national long-term programme for the development of research and technology. At the beginning there was a survey of all the researchers involved in biotechnology, their interests and potentialities and then the diversity of the conducted research. With these data, the information about the advances in biotechnology worldwide and the needs of our country, a general plan of goals was established consisting of:

- Strengthening and funding research activities of already existing research centres dealing with biotechnology.
- Foundation of new research centres in important areas of biotechnology not existing yet in Greece (foundation of the Institute of Molecular Biology and Biotechnology, foundation of the Department of Biotechnology at the Pasteur Institute).
- Funding research activities of Universities, Research Institutes of the Ministry of Agriculture, and industries of the public and private sector dealing with biotechnology.
- Foundation of state firms or funding laboratories from the private sector for exploiting the applications of the biotechnological research (i.e. Biohellas and Vitro Hellas, respectively).
- Promoting cooperation between research centres and industries.
- Participation in the research programmes of the European Communities concerning research in biotechnology and mobility of scientists for training in Institutes preferably of other countries (i.e. an agreement was signed with the University of Florida for cooperation in the area of agricultural biotechnology).

Categories of research programmes

The research programmes which have been designed and developed for funding by the GSST are divided into four sectors:

a. Programme for the development of industrial research (PAVE)

This programme is aimed at the development of innovated and improved methods of production and the increase of enterprise productivity. Cooperation between Universities or Research Centres and Industry is encouraged. GSST's contribution to projects is up to 50% of the

actual costs and there is no limit in the budget. This programme started in 1985 and is of a two-year period.

b. Programme for professional training

The objectives of this programme are to attract junior scientists for their training in research, to retain highly-qualified research personnel and to invite Greek researchers who live abroad to collaborate with counterparts in Greece. This programme was mainly designed for the Universities and the Research Institutes and is financed 100% by the GSST. The projects budget cannot exceed the upper limit of 10 million drachmas and the duration is two years. This programme was put into effect in 1987.

Selection of proposals

Until 1988 in all programmes the grants were awarded through the criterion of quality rather than the predetermined category. From 1989 on priorities on funding were based both on a predetermined area and high quality of research.

The submitted proposals should indicate expected benefits and/or look promising for exploitation in the near future. All proposals are examined and evaluated by experts selected by the GSST (*Fig. 1*).

Research activities in the public sector

Biotechnology research is being conducted in four industries and Research Centres (1-4) which are under the supervision of the GSST, and six Institutes and Research Stations of the Ministry of Agriculture (5-10). Also, it is conducted in a number of University Departments and Laboratories.

1. Institute of Molecular Biology and Biotechnology (Heraklion)

It is located at Heraklion, Crete. Most of the research projects deal with plant technology such as:

- Cell and tissue culture
- Protoplast culture
- Virus purification from plant tissues and production of antibodies and virus diagnosis by the Elisa test
- Isolation of doubleclone RNA for virus diagnosis in grapes

- Molecular mechanisms between pathogen and host plant.

2. Institute of Biology (Athens). The projects are mainly devoted to agriculture and related to the control of the environment. Some of the projects are:

- Integrated pest management
- Development of new techniques for disease control without the use of fungicides
- Enzyme production for agricultural waste utilization.

3. Institute Pasteur, biotechnology department (Athens)

Production of monoclonal antibodies for controlling foot and mouth disease virus (FMDV).

4. Centre of biological research, National Research Institute (Athens). Production and improvement of proteases and lipases from lactic acid bacteria.

Under the supervision of the Ministry of Agriculture five Institutes and Research Stations are engaged in developing and applying biotechnological methods for production of healthy propagation material, protection against pests and exploitation of agricultural crop residues.

5. Benakion Institute of Phytopathology (Athens). The projects are focused on:

- Biological control of pests and diseases
- Production of virus-free citrus plants (micrografting technique)

6. Institute of Technology for Agricultural Products (Athens)

There are three main projects:

- Production of liquid wastes from the oil-factories for production of alcohol and other chemicals.
- Exploitation of the agricultural industry by-products rich in lignin and cellulose by using biotechnological methods.

7. Station of Technology for Plant Propagation Material (Athens)

It is conducting applied research on grapes, potatoes, and strawberries aimed at:

- Production of virus-free *Vitis* plantlets through meristem culture for vineyard replantations
- Virus elimination from *Solanum tuberosum* populations and creation of new varieties and/or clones
- Production of *Fragaria* virus-free mother plants through thermo-therapy and meristem culture.

8. Research Station for Fruit Trees

(Thessaloniki). The main emphasis is on micropropagation of fruit trees such as apple, cherry, and pear trees as well as the rootstock GF677 (*Prunus opersica* and *Prunus amygdalus*). Healthy plants are delivered to growers for orchard replantations.

9. Institute of Viticulture, Vegetable Crops and Floriculture (Heraklion). A project is underway on soil compost production via biotechnological methods from the agricultural industry residues and by-products.

10. Institute of Sub-Tropical Plants and Olive Tree. Applied research on in vitro propagation of plant species such as banana, avocado, kiwi and jojoba.

The research in biotechnology underway at Universities is very broad and far-reaching. An effort is being made to name simply the projects at the various research units.

Aristotle University (Thessaloniki)

1. LABORATORY OF GENETICS AND PLANT IMPROVEMENT

- Production of high yielding corn hybrids by using genetic engineering methods
- Creation of new varieties in *Vicia faba* resistant to *Sclerotinia*

2. LABORATORY OF FLORICULTURE

- Production of healthy plant propagation material through in vitro culture
- Virus elimination by using new in vitro techniques
- Somatic embryogenesis in economically important ornamentals.

3. LABORATORY OF POMOLOGY

- Study of graft incompatibility in fruit trees by enzymatic methods.

4. LABORATORY OF VITICULTURE

- Introduction of new varieties and clones in table grapes via in vitro techniques.

5. LABORATORY OF FORESTRY GENETICS

- Improvement of *Pinus* and *Abies* species by using tissue cultures.

6. DEPARTMENT OF BIOLOGY

- Improvement of ecological traits of *Rhizobium* with the application of recombinant DNA technology.

Agricultural University of Athens (Athens)

1. LABORATORY OF FRUIT TREES

- Improvement of the micropropagation methods for woody plants - apple, peach, cherry and olive tree.

University of Ioannina (Ioannina)

1. LABORATORY OF ORGANIC CHEMISTRY AND BIOCHEMISTRY

- High yield ethanol production with the use of the bacterium *Zymomonas mobilis* in the fermentation of various agricultural products.

National Polytechnic University of Athens (Athens)

1. LABORATORY OF TECHNOLOGY OF BIOSYSTEMS

- Production of enzymes from microbial cultures for the food industry.

Applications of Biotechnology in the public and the private sector

The opportunities of biotechnology in agriculture are very promising. The accumulative knowledge can lead to more efficient agricultural production. A lot of advances have been achieved in two public enterprises using biotechnological methods in the production and the same is true for a number of private companies.

1. **Bio Hellas S.A. (Athens).** This is a public company founded in 1984 and aimed at:

- Production of virus-free potato seed through in vitro culture
- Production of veterinary vaccines
- Production of proteins from the exploitation of the milk whey.

2. **Hellenic Sugar Industry S.A. (Thessaloniki).**

This is a public enterprise with a research laboratory, founded in 1986, to meet challenges in producing disease-resistant sugar beet varieties. A project is underway to solve the problem of the disease *Cercospora*.

3. **Vioryl S.A. (Athens).** A very active private company both in research and production.

- Production of secondary metabolites from suspension cultures
- Production of healthy plant propagation material through tissue culture in a number of horticultural plant species (i.e. strawberry, kiwi, banana, lilium, orchid, rose, etc.).

4. **Vitro Hellas S.A. (Alexandria).** This company was founded in 1988, and produces on a big scale plants from in vitro cultures, mainly peach rootstocks (GF677) and kiwis.

5. **Avramis Nurseries Ltd. (Yiannitsa).** This company started to produce in vitro rose plants in 1989.

6. **Microculture Ltd. (Athens).** A number of floricultural crops and woody ornamentals are produced through tissue culture.

Economical aspects

Most of the funds (approx. 75%) which support the research in biotechnology come from state resources (i.e. GSST, Ministry of Agriculture). The rest of the funds (i.e. 25%) are given by the state enterprises, the private sector and other sources (Fig. 2).

The amount of money granted to biotechnological projects from 1985 to 1988 appears in Fig. 3. There is an increase in financing the research in biotechnology from 1984 to 1988.

Among the researchers in various disciplines, 13.4% of them work in the agricultural sector; however there are no data at the present time, for the number and percentage of researchers involved in biotechnology (Fig. 4). There is a continuous encouragement for professional training by visiting other Research Centres

or participating in related training programmes (i.e. COMETT).

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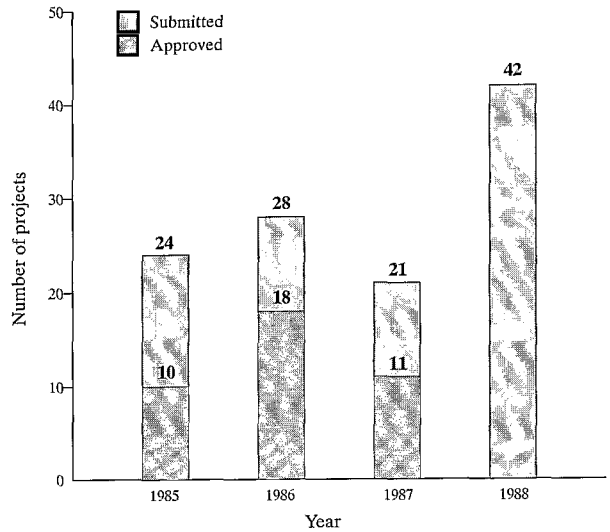


Fig. 1. Submitted to GSST and approved research projects in biotechnology

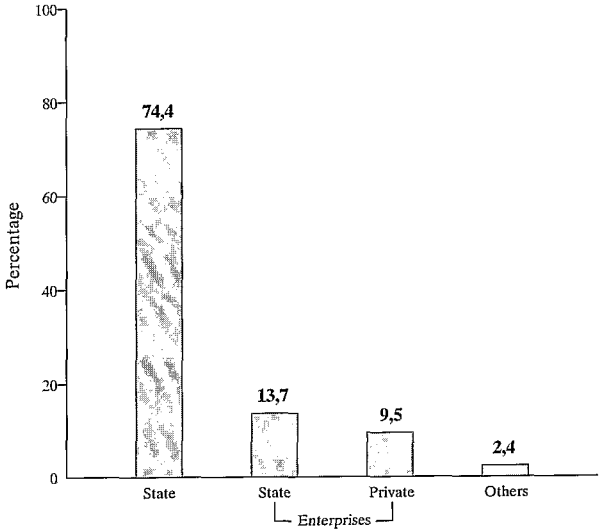


Fig. 2. Financing of scientific and technological research in Greece (1986)

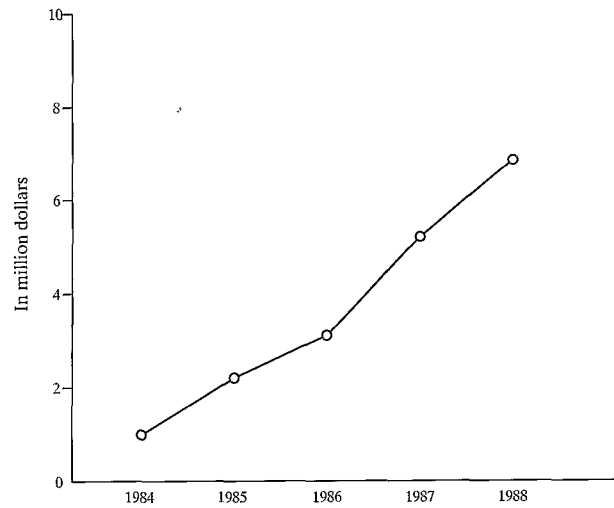


Fig. 3. State funds for biotechnology in Greece

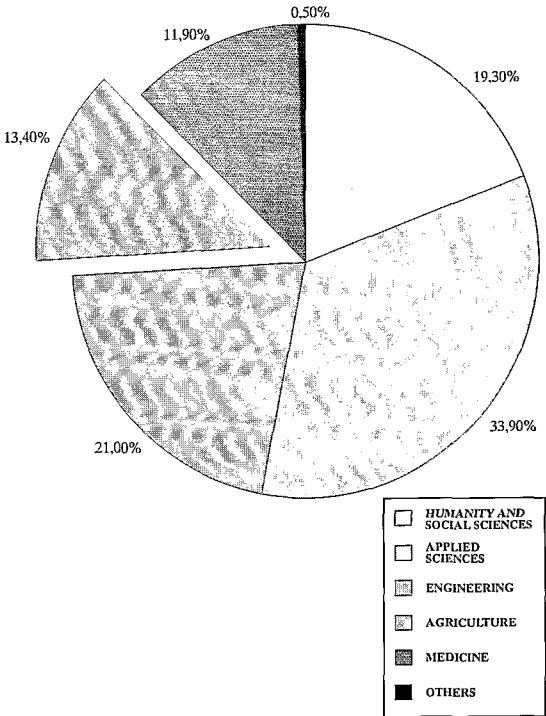


Fig. 4. Participation of researchers per scientific sector in Greece