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Strategies developed by Mediterranean Countries: Spanish National R&D Plan

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SUMMARY - The Spanish Government has developed a National Plan for Scientific Research and Technological Development, regarding the following areas: staff training, funding of research projects, equipment, budget for joint programs between research centers and firms. A table is included showing the eleven selected programs concerning Quality of Life and Natural Resources. Agriculture-oriented biotechnologies are included in two national programs: one for Biotechnology, and one for Agriculture. The main policies and budgets of each program are indicated in this paper. The National Plan is also aimed at the development of a National Biotechnology Center, to be located in the Madrid area, near the Molecular Biology Center. Finally, in order to develop positive applications, a network of agencies (network OTRI - OTT) will be implemented for the transfer of research and technological results.

Key words: Biotechnologies in Spain - Plan for Scientific Research and Technological Development - Cell biology - Molecular biology - Microbiology - Technology transfer.

RESUME - "Le Plan National Espagnol de Recherche et Développement". Le Gouvernement Espagnol a mis sur pied un Plan National de Recherche Scientifique et de Développement Technologique qui porte sur les points suivants : formation du personnel, financement de projets de recherche, équipement d'infrastructures, budget pour actions jointes entre centres de recherche et entreprises. Un tableau précise les 11 programmes retenus pour le secteur Qualité de la Vie et Ressources Naturelles. Les biotechnologies tournées vers l'agriculture sont réparties en deux programmes nationaux : celui de la Biotechnologie et celui de l'Agriculture. Les grandes lignes d'action et les budgets de chacun de ces programmes sont présentés. Le Plan prévoit également le développement d'un Centre National de Biotechnologie qui sera situé dans la région de Madrid, à proximité du Centre de Biologie Moléculaire. Enfin, pour faciliter les applications concrètes, un réseau d'Offices (réseau OTRI-OTT) sera mis en place pour le transfert des résultats de la recherche et des technologies.

***Mots-clés** : Biotechnologies en Espagne - Plan Recherche Développement - Biologie cellulaire - Microbiologie - Transfert de technologie.*

The Spanish Law for the Promotion and General Coordination of Scientific and Technical Research, approved in 1986, establishes mechanisms for:

- Coordinating the activities of production sectors and universities in the field of research.
- Defining priority lines.
- Increasing the resources dedicated to research.

For this purpose the law establishes the National Plan for Scientific Research and Technological Development (National R&D Plan) as the basic instrument for the planning, development and coordination of the Spanish system of science and technology. This Plan has set up priorities over a number of years, initially four, and its major aims are to establish objectives in all research and development activities, in order to stimulate the capacity of innovation of enterprises and to mobilize public and private resources into areas of special strategic interest in our country.

These aims and objectives are to be attained through the four types of actions supported by the National R&D Plan, namely:

- Training of research personnel
- Financing research projects
- Financing scientific infrastructure

- Financing joint projects between research centers and enterprises.

All the above-mentioned actions are evaluated through a peer review system by an independent body, the National Agency of Evaluation and Prospective, and the final decisions taken by "ad hoc" committees made up of members of the scientific community.

Specific programs, which are classified into four different areas, have been created. In the area of Quality of Life and Natural Resources, there are eleven programs (Table I).

Most of these programs have been open for calls in 1988, and every year thereafter, except those of Human Health, Animal Sciences and Environment which were initiated in 1989. As shown in Table I, there are specific programs of Biotechnology, Agriculture, Animal Sciences (Livestock and Husbandry), Food technology, Forestry, Environment, which are closely related to the topic of this meeting. Some programs, as it occurs with Biotechnology, have had a mobilizing preceding program in 1986 and 1987.

All the programs have their specific objectives and in many cases, like Biotechnology and Agriculture, it is very difficult to establish the borderline between them. The total budget of the National Plan for 1988 was 130 million $ (1$ = 100 pesetas); 190 million were expended in 1989 and a total of 240 has been approved for 1990. The distribution of 1988 and 1989 budgets is shown in Fig. 1 and 2.

Agricultural Biotechnology is mainly supported by two National Programs: Biotechnology and Agriculture. Tables II and III show the scientific and technological objectives of these two programs.

National program of biotechnology

The budget of the Program of Biotechnology has been very close to 10% of the total budget of the National R&D Plan. In 1988 it represented more than 13 M$, distributed as shown in Fig. 3. In that year the highest portion of the budget was dedicated to infrastructure, followed by joint projects.

The distribution of the budget for 1989 (18.1 M$) is shown in Fig. 4, infrastructure being the largest part of it. This is due to the fact that the National R&D Plan is strongly supporting the construction of the National Center of Biotechnology in Madrid, which is nearly ready to be opened.

There is however a lack of correspondence between the amounts approved every year in the different actions and the budgets shown. This is due to two facts: 1. the budget considers the fundings for the first year of the projects approved in that particular year, plus the second and third payments of the projects approved in the preceding years. The same applies to fellowships which in general are granted for a four years 2 term. The call for projects in 1988 was quite late, and therefore many were approved in 1989. Nevertheless we have considered them as 1988 projects since their applications were submitted in that year. Having this in mind we can see in Fig. 5 that 59 projects were approved in 1988 with a total budget of 6.96 M$, Agriculture and Food Biotechnology representing a 22% of the total. The infrastructure financed in the same year amounted to 2.54 M$. Its distribution by Autonomic Communities (Fig. 6) shows the highest figures in Madrid, followed by Catalonia, Andalousia and Valencia. There was also a contribution of 2 M$ for the National Center of Biotechnology (CNB).

In 1989 31 projects with a total budget of 2.93 M$ were approved. From these only two, representing 6% of the budget, correspond to the objective of Agriculture and Food Research (Fig. 7). In the same year the total amount spent in infrastructure was 4.66 M$ plus 3.34 for the CNB (Fig. 8). In this case, most of the funding went to Catalonia, followed by Madrid, accounting both for nearly 50% of the budget.

National program of agriculture

This program is divided in the four main objectives shown in Table III.

The actions are the same as in other programs, and the 1988 budget (8.8 M$) is shown in Fig. 9. In 1988, Soil and Water Management was the scientific objective with more projects approved, followed by plant breeding, IPM and Horticulture and Fruitculture (Fig. 10). In this year a total of 19 actions of infrastructure were approved, amounting to 2.46 M$, distributed in five autonomic communities (Fig. 11).

In 1989 the total budget of this program was 9.80 M$, as indicated in Fig. 12, with the research grants as the largest portion of it. A total of 48 projects were approved plant breeding being the objective with the highest number of projects approved (Fig. 13). The same year 30 actions of infrastructure were financed. They were distributed in 9 Communities, with a total budget of 2.56 M$ (Fig. 14)

Other programs in which Agriculture and Biotechnology have been funded are Food Technology, Forestry, and Environment. In 1988 a total of 7 projects related to Biotechnology in Agriculture were approved in the Program of Food Technology with a total budget of 2.07 M$, and in 1989, 13 projects distributed in Food Technology (7), Animal Sciences (5), and Environment (1), amounting 0.97 M$.

Fellowships

One of the most important aspects of the National R&D Plan is to increase the number of scientists and the quality of scientific research. To this purpose grants are available not only to work in Spanish institutions but also in foreign research centers. Table IV shows the distribution of grants awarded in 1988 and 1989 in the different programs of the area of Quality of Life and Natural Resources. These grants are for 3 years in Spain (with possibilities of renewal for another year) and for 2 years in foreign laboratories.

Joint projects

To increase the technological level and the competitiveness of Spanish enterprises, joint projects between enterprises and research institutions are a very important objective of the National Plan. These projects are managed by the Center for Industrial and Technological Development (CDTI) of the Ministry of Industry and Energy. In the field of Biotechnology, 7 projects were approved in 1988, with a total budget of 7.3 M$, from which 50% was public financing. In 1989, 12 projects were supported with similar figures for total budget and percentage of public funding. In the program of Agriculture, there was 1 project approved in 1988, with a total budget of 2.3 M$ and a public financing of 1.6, and in 1989, 3 projects with a budget of 6.0 M$ received 1.7 M$ of public funding.

National center of biotechnology

A new Center of Biotechnology in the Madrid area, close to the Molecular Biology Center, in the campus of the Autonomous University, and near one of the technological campuses of Madrid, will be opened at the end of the present year. With a total surface of 12,000 m2, the Center will have three main laboratories: Cellular Biology, Microbiology and Molecular Plant Biology. High qualified research professionals have been appointed as heads of these laboratories. Close relations with enterprises and research institutions, national and foreign, are expected to be developed in this center.

Transfer of technology

With the aim of establishing a better connection between centers of research and enterprises has been created the OTRI-OTT network. The OTRI are Offices for the Transfer or the Research Results located in Universities, Government Laboratories (like the Research Council or the Institute for Agricultural Research) and Research Associations. Their services can be summa-rized as follows:

- To provide data banks, whith the infrastructure and R&D output of their respective institutions.
- To identify the transferable results obtained by the research groups and to bring them to the notice of enterprises.
- To facilitate the transfer of results
- To collaborate and participate in the drawing-up and negotiation of research contracts, technical assistance, licences etc..
- To provide information about European R&D programs and assist with the drawing-up of projects for presentation and their subsequent follow-up.
- To collaborate and participate in the exchange of research personnel between industry and Public Research Centers.

The OTT is the Office for Technology Transfer, of the National R&D Plan, which coordinates the activity of the different OTRI and fosters the transfer of their results. Briefly, the OTT functions are:

- Elaboration and updating of the data base with the overall technological output of Public Research Centers (Universities, Government Laboratories etc...).
- Collaboration with the CDTI and other institutions related to the enterprises to facilitate the industrialization of technologies originated in Public Research Centers.
- Technical advice to the OTRI regarding patents, contracts, feasibility studies, European R&D Programmes etc...

Two specific programs have been included in the R&D Plan in order to stimulate this transfer: The Program for the Stimulation of the Transfer of Research Results (PETRI), which provides additional funding to those projects which have transferable results, and a Program for the Exchange of Personnel between Enterprises and Research Centers, both in Spain and other countries. This program will be soon implemented with the possibility of giving fellowships to young people willing to do the experimental work of their thesis in industry.

In summary, under the National R&D Plan has been established a system of funding R&D activities as well as a network to improve our system of Science and Technology and the transfer of this technology to enterprises. A policy that favors R&D activities in the industrial sector has also been set up by the Ministry of Industry and Energy.

Table 1 : National R & D plan: programs

NATURAL RESOURCES AND QUALITY OF LIFE (11)

- Biotechnology
- Agriculture R & D
- Animal Sciences
- Food Technology
- Forestry
- Environment
- Sports
- Human Health
- Pharmaceutical R & D
- Geological Resource
- Marine Res. & Aquaculture

PRODUCTION AND COMUNICATIONS (7)

SOCIAL AND CULTURAL STUDIES (3)

HORIZONTAL AND SPECIAL PROGRAMS (5)

Table 2 : National program of biotechnology

1. Basic research Biotechnology-oriented.
2. Agriculture and food.
   - Cell and tissue culture.
   - Genetic engineering of plants and associated microorganisms.
   - Genetic engineering of animals of interest in agriculture, forestry or husbandry.
   - Genetic engineering of microorganisms involved in agro-food processes.
3. Human and animal health
4. Industry
5. Biodegradation and control of pollution

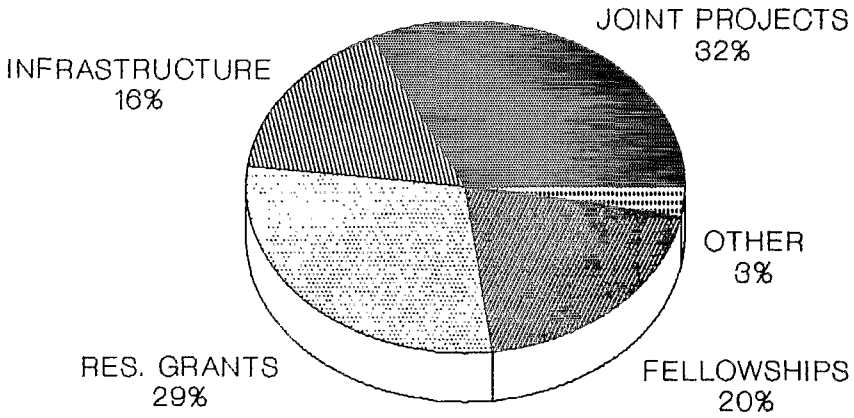
Table 3 : National program of agriculture R & D

- Plant breeding.
- Management and conservation of soils of agricultural use.
- Integrated Pests Management.
- Horticulture and Fruitculture.

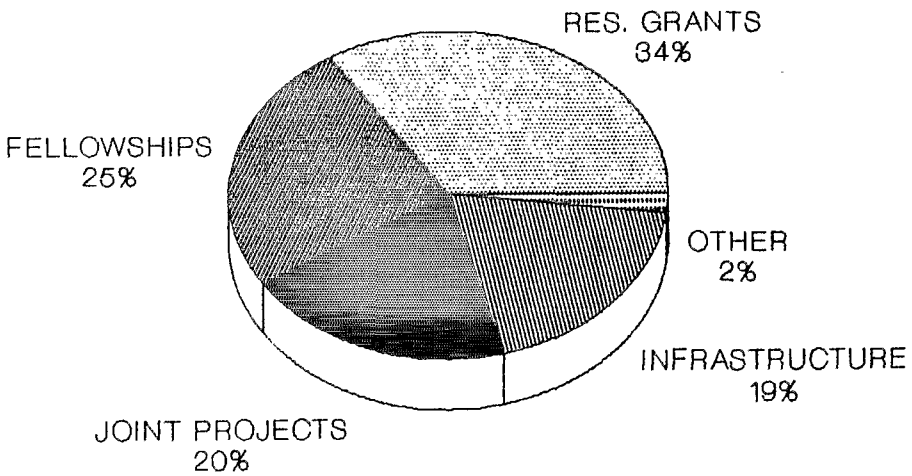
Table 4 : Fellowships 1988, 1989. Area of quality of life and natural resources

PROGRAM	SPAIN		OTHER COUNT	
	1988	1989	1988	1989
Agri	66	23	55	19
An. Sci	33	8	34	7
Aqua	12	6	16	5
Bio	46	15	39	19
Env			48	13
Food	15	10	39	19
For			24	0
Geo	33	5	19	10
Health	54	28	82	30
Phar	17	10	19	22
Sports	5	5	5	2

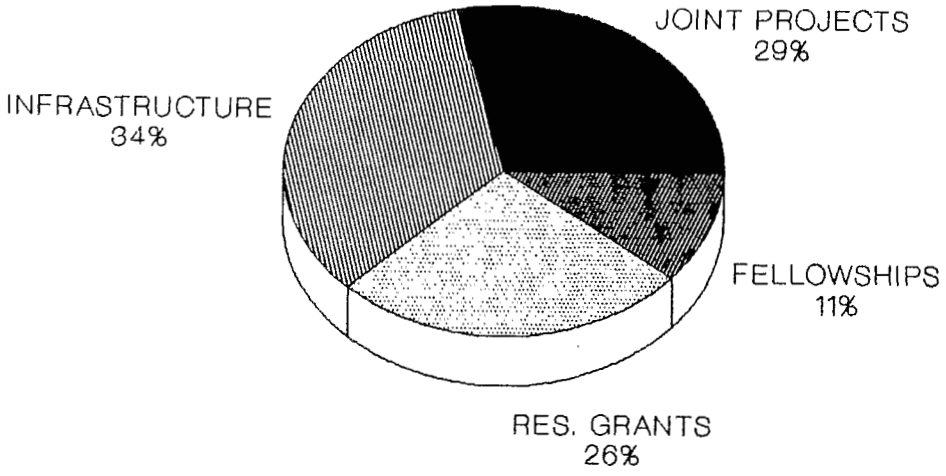
NATIONAL R & D PLAN:
BUDGET (130 M$) DISTRIBUTION, 1988 (Figura 1)



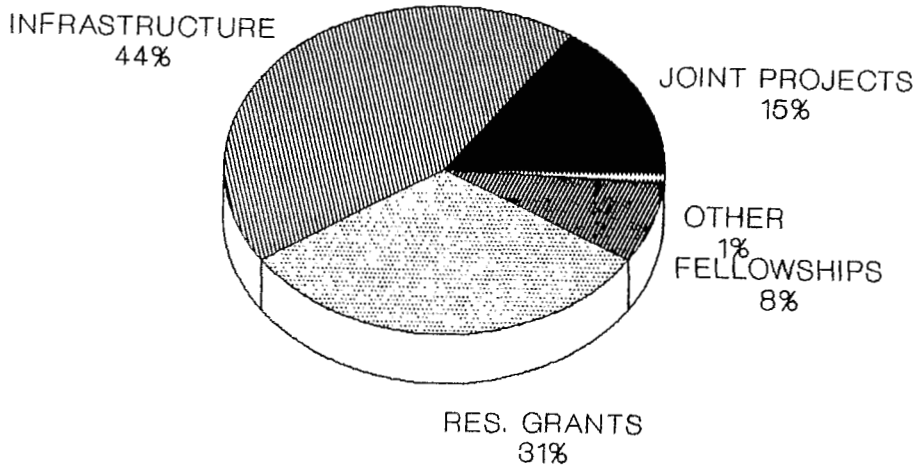
NATIONAL R & D PLAN:
BUDGET (197 M$) DISTRIBUTION, 1989 (Figura 2)



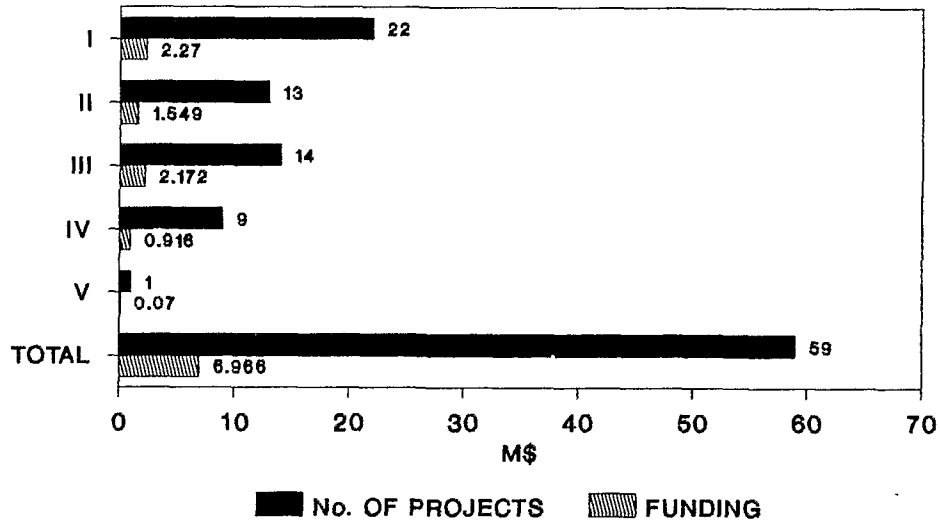
BIOTECHNOLOGY
BUDGET DISTRIBUTION (13.37 M$), 1988 (Figura 3)



BIOTECHNOLOGY
BUDGET DISTRIBUTION (18.1 M$), 1989 (Figura 4)

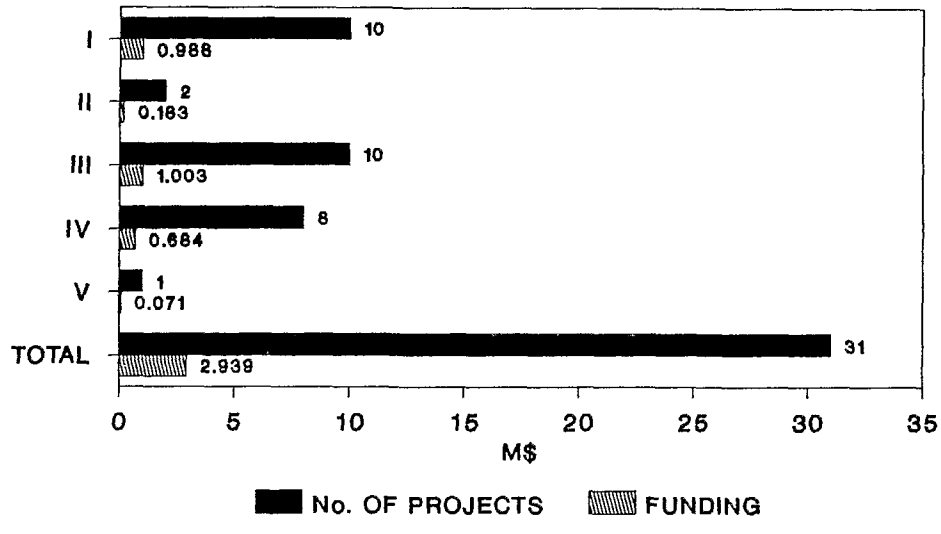


BIOTECHNOLOGY: DISTRIBUTION OF RESEARCH GRANTS BY SCIENTIFIC OBJECTIVES (1988) (Figura 5)



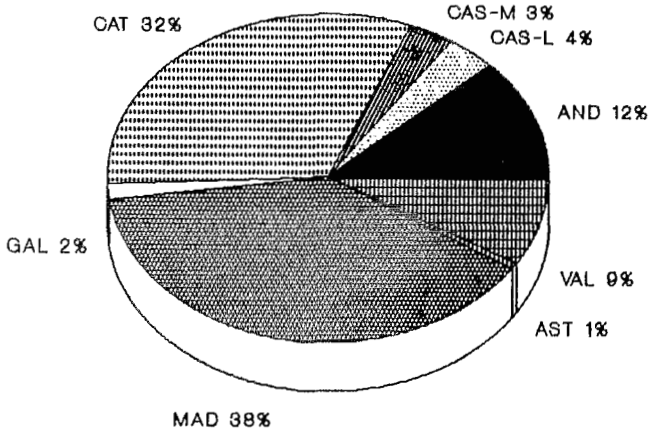
I-BASIC RES II-AGRI&FOOD III-HEALTH
IV-INDUSTRY V-BIODEGRADATION

BIOTECHNOLOGY: DISTRIBUTION OF RESEARCH GRANTS BY SCIENTIFIC OBJECTIVES (1989) (Figura 6)



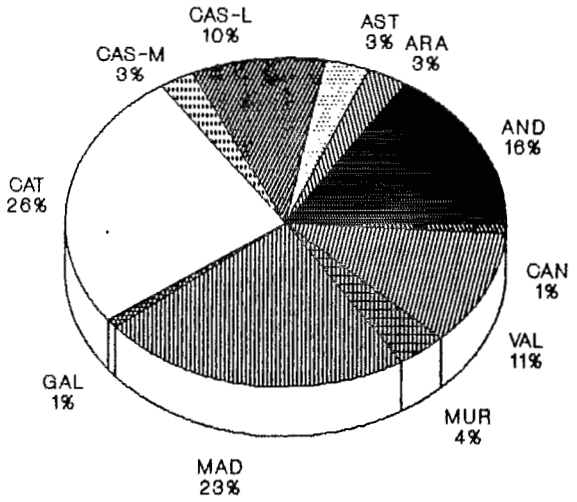
I-BASIC RES II-AGRI&FOOD III-HEALTH
IV-INDUSTRY V-BIODEGRADATION

BIOTECHNOLOGY: INFRA 1988 (Figura 7)



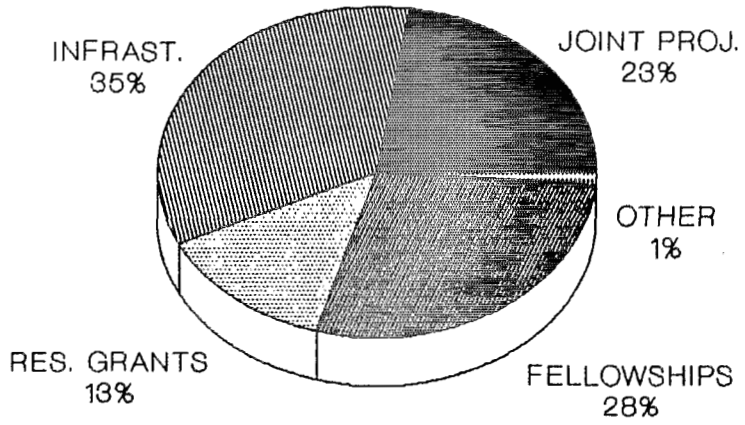
TOTAL BUDGET = 2.54 M$ + 2.00 CNB

BIOTECHNOLOGY: INFRA 1989 (Figura 8)

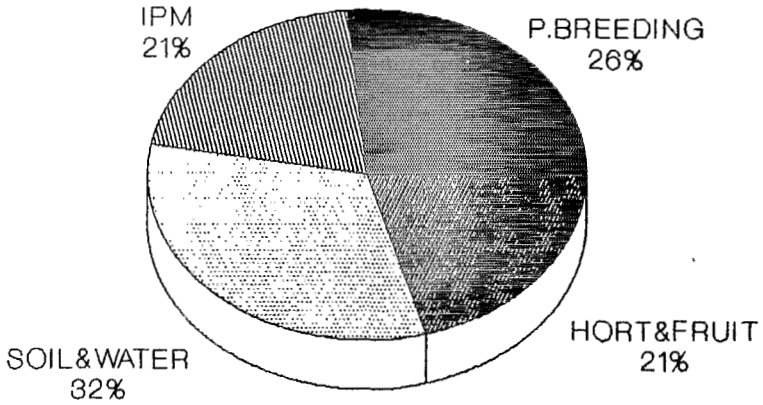


TOTAL BUDGET = 4.66 M$ + 3.34 CNB

AGRICULTURE R & D PROGRAM:
BUDGET (8.4 M$) DISTRIBUTION, 1988 (Figura 9)

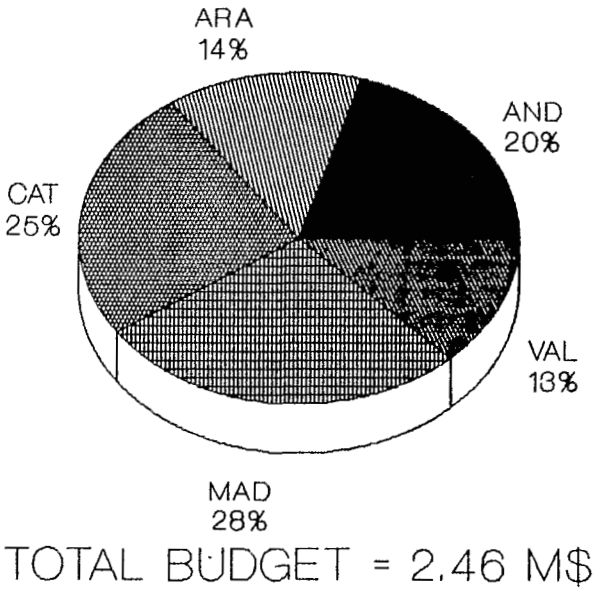


AGRICULTURE R & D PROGRAM: DISTRIBUTION OF GRANTS BY SCIENTIFIC OBJECTIVES (1988) (Figura 10)

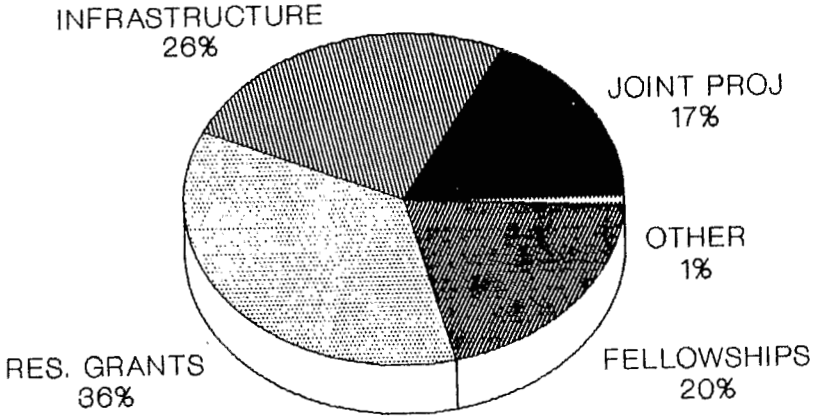


ALLOCATED BUDGET = 2.5 M$

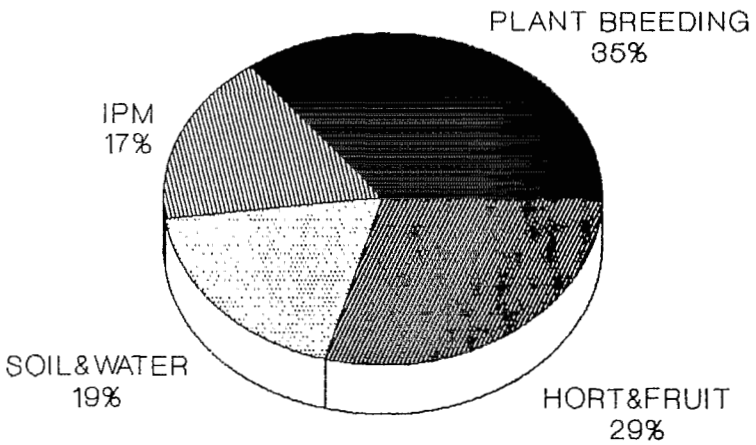
AGRICULTURE R & D: INFRA 1988 (Figura 11)



AGRICULTURE R & D PROGRAM:
BUDGET (9.5 M$) DISTRIBUTION, 1989 (Figura 12)



AGRICULTURE R & D PROGRAM: DISTRIBUTION OF GRANTS BY SCIENTIFIC OBJECTIVES (1989) (Figura 13)



AGRICULTURE R & D: INFRA 1989 (Figura 14)