

Agricultural Biotechnology in the Philippines

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Agricultural biotechnology is officially recognized by the Philippine government as a tool to attain food security and sustainable agriculture, promote health and food safety and provide people empowerment. This paper traces the development of agricultural biotechnology in the country starting with plant tissue culture activities in the 1960s. Among those utilized at commercial scale are micropropagation of banana and orchids, micropropagation of disease-free sugarcane seed buds for distribution to growers, and to a limited extent, embryo culture of the mutant coconut makapuno. Fermentation-based technologies for agricultural application include soil inoculants, biocontrol agents, enzymes and diagnostics for food and animal diseases. Development of transgenic crops such as papaya with delayed ripening trait and virus resistance and rice with insect and pathogen resistance is ongoing at several institutions. Regulation of R & D of modern biotechnology projects is in place while the regulatory framework for commercialization is being worked out. Only one field trial of Bt corn has been carried out; preparations for other limited field trials of Bt corn and transgenic rice are underway.

INTRODUCTION

Agriculture including fishery is vital to the Philippine economy. Agriculture's contribution to the economy has always been substantial. In 1995, it registered a growth rate of 3.2 percent and its contribution to the gross domestic product is about 23 percent. The country's population is predominantly rural (70 percent of the total) and two-thirds of this population depends on agriculture for their livelihood. Agriculture employs about half of the total labor force. Hence, a sustained expansion of the national economy requires sustained growth in the agricultural sector. This attaches the high priority of transforming agriculture into a modern, dynamic, and competitive sector.

Philippine agriculture consists of rice, corn, coconut, sugar, banana, other crops, livestock, poultry, and fishery production activities. Biotechnology has yet to make inroads into the improvement of these production activities. The major biotechnology industry in the Philippines consists of the traditional large-scale fermentation industries in beer production, alcohol distillation, monosodium glutamate production, soy sauce and vinegar production, and of small-scale production systems for animal vaccines, nata de coco, bagoong, basi, and other Philippine fermented products. Tissue culture of banana may or may not be integrated into the large-scale commercial production of banana. Sugarcane tissue culture is integrated with sugarcane production and the system is run by an institution (PHILSURIN) supported by the industry. There are small-scale tissue culture laboratories integrated with orchid production.

AGRICULTURAL BIOTECHNOLOGY R & D

Biotechnology R&D in the Philippines formally started with the establishment of the National Institutes for Microbiology and Biotechnology (BIOTECH, now called

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National Institutes for Molecular Biology and Biotechnology), University of the Philippines Los Banos (UPLB) in 1979. Earlier, also at UPLB, tissue culture of coconut (the mutant macapuno) was started at the Department of Agricultural Botany by the late Professor Emerita de Guzman and of banana and rattan at the Institute of Plant Breeding . Within the past two decades, in addition to other UPLB units like Department of Horticulture, Institute of Animal Science, several agencies were also engaged in agricultural biotechnology R&D, namely: Philippine Rice Research Institute (PhilRice-DA), Philippine Coconut Authority (PCA-DA), Bureau of Plant Industry (DA-BPI), Visayas College of Agriculture (ViSCA) University of the Philippines Visayas, Benguet State University, University of the Philippines Diliman and Central Luzon State University (CLSU). Most of the R&D, and especially at BIOTECH, was on the development of fermentation-based technologies for agricultural applications such as production systems for soil inoculants, biocontrol agents, vaccines, enzymes, diagnostics and foods/feeds, and plant tissue culture. Unfortunately, biotechnology R&D is very much under-funded except for projects on enzymes, animal vaccines, and diagnostics. There is no focus with funding spread among too many projects and the facilities and infrastructure support inadequate. In addition, the majority of Philippine researchers lack appropriate skills in modern biotechnology and fermentation engineering and the few trained are spread among a number of institutions.

Of the technologies, plant tissue culture, requiring less capital to develop and use, has been adopted for production of planting stock in large- and small-scale banana tissue culture laboratories; in networks of sugarcane, coconut, and abaca tissue culture laboratories; and modest-scale orchid culture operations. The fermentation-based technologies developed are yet to be commercialized despite demonstrations of effectiveness such as increased yields with soil inoculants substituting for chemical fertilizer or biocontrol agents substituting for chemical pesticides. Marker-assisted breeding is being carried out on mungbean, tomato, rice, mango, and coconut at the UPLB Institute of Plant Breeding where useful genes have also been isolated and staff members sent abroad to train and work on papaya transformation. Transformation of Xa21 rice was done at PhilRice and has recently been tested in the field. Only one instance of a field test of a genetically modified corn (Bt corn) has been carried out that demonstrated the effectiveness of the Bt gene in protecting the corn plant from the Asiatic corn borer, an insect causing 30-80 percent damage in corn.

Previously, the major funding agency for agricultural biotechnology R&D are three councils of the Department of Science and Technology namely: Philippine Council for Agriculture and Resources Research and Development (PCARRD), Philippine Council for Advanced Sciences Research and Development (PCASTRD) and Philippine Council for Industry and Energy Research and Development (PCIERD). The Department of Agriculture through its Bureau of Agricultural Research (DA-BAR) intends to provide substantial funding for agricultural biotechnology including the basic science foundation for biotechnology.

Last year, the DA-BAR organized the Biotechnology RDE Network, comprised of the following research institutions that will implement a national agricultural biotechnology agenda and program: the National Institutes of Molecular Biology and Biotechnology-University of the Philippines System, College of Agriculture-UPLB, College of Arts and Sciences-UPLB, Marine Science Institute-University of the Philippines, Natural Sciences Research Institute-UP Diliman, Visayas College of

Agriculture, and Benguet State University. This Network shall conduct research on basic sciences and problems that cut across various commodities.

In addition, biotechnology research specific to an agricultural commodity is also undertaken by other institutions belonging to commodity networks such as PhilRice-DA, PCA-DA, Philippine Carabao Center (PCC-DA) and Bureau of Plant Industry (BPI-DA). Furthermore, the Department has also included in its recently signed loan agreement with the Asian Development Grant US\$34 million for rice biotechnology R&D and also part of the US\$11 million for corn research is intended for corn biotechnology R&D. The Department is poised to sign this week a memorandum of agreement with the USDA for the latter to provide technical assistance to the DA Biotechnology Program to be funded with US\$7 million from proceeds of a commodity loan from the USA. The program shall be implemented by DA agencies, UP units, and other state universities.

BIOTECHNOLOGY REGULATION

Regulation of modern biotechnology covers only research and development and is administered by the National Committee on Biosafety of the Philippines, a multiagency committee coordinated by the Department of Science and Technology and institutional biosafety committees. The Department of Agriculture is conducting a study on policies for regulation covering the commercial production or use of biotech products. We have recently passed an Intellectual Property Act that specifically excluded plant and animals from patents but included microorganisms for patent protection. We have a pending bill in the House and the Senate on plant variety protection.

There is a small foreign-funded group trying to block the commercial planting and entry of GMOs in the country and has actively tried to block the field test of Bt corn through a very effective system of disseminating misinformation. This campaign has resulted in the passing of a resolution to block the Bt corn field test by the General Santos City Council, resolutions at the House and Senate to investigate the field test, a pending bill at the Senate calling for a ban on GMOs and the filing of a trumped up charge against the DOST, DA and IPB in connection with the Bt corn field test at the Supreme Court which dismissed the case. The anti-GMO group appears to be going around the country campaigning. There are also reports of Roman Catholic priests strongly advising parishioners in their homilies to reject Bt corn.

BIOTECHNOLOGY EDUCATION AND TRAINING

Microbiology courses and curricular programs are offered by several institutions in the Philippines. The first molecular biology course was offered as part of the BS Biology program at the UPLB in 1976. The Natural Sciences Research Institute, UP Diliman first offered a short-term training course on cell and molecular techniques in 1987 and offers annually similar training courses since. The College of Science, UP Diliman started offering academic programs for the degrees, BS, MSc and PhD in Molecular Biology and Biotechnology in 1987. Laboratory facilities for these programs had been provided by the Department of Science and Technology. The BS program has a restricted enrollment of 40 students per year. In 1999, UPLB started offering MS in Molecular Biology and Biotechnology program. The UP Diliman academic programs

have produced as of this year more than 200 BS graduates, 3 MS and 5 PhDs. Many of the BS graduates have gone on to medicine and graduate studies.

THE BIOTECHNOLOGY POLICY OF THE DEPARTMENT OF AGRICULTURE

The policies and programs of the Department of Agriculture are guided by two major pieces of legislation, the Agriculture and Fisheries Modernization Act of 1997 (AFMA) and the Fisheries Code of 1998. Both laws provide for support for research and development but it is the AFMA that has a specific provision for biotechnology. AFMA provides that the development of agriculture and fisheries shall be in accordance with the following principles:

Food security – assuring the availability, adequacy, accessibility and affordability of food supply to all at all times including sufficient local production of rice and white corn.

Poverty alleviation and social equity – ensuring that the poorer sectors of the society have equitable access to resources, income opportunities, basic and support services and infrastructure, especially in areas where productivity is low as a means of improving their quality of life as compared with other sectors of society

Rational use of resources – adopting a rational approach in the allocation of public investments in agriculture and fisheries in order to assure efficiency and effectiveness in the use of scarce resources and thus obtain optimal returns on investments

Global competitiveness – enhancing the competitiveness of the agriculture and fisheries sectors in both foreign and domestic markets

Sustainable development – promoting development that is compatible with the preservation of the ecosystem in areas where agriculture and fisheries activities are carried out and exerting care and judicious use of the country's natural resources in order to attain long-term sustainability

People empowerment – enabling all citizens the opportunity to participate in policy formulation and decision-making by establishing appropriate mechanisms and by giving them access to information

Protection from unfair competition – protecting small farmers and fisherfolks from unfair competition by promoting a policy environment that provides them priority access to credit and strengthened cooperative-based marketing system

1. The AFMA provision on biotechnology

The authors of the Agriculture and Fisheries Modernization Act of 1997 have fully recognized the importance of biotechnology in modernizing Philippine agriculture. In fact, Agriculture Secretary Edgardo J. Angara then Chairman of the AGRICOM that drafted the AFMA specifically included a biotechnology provision. The law specifically provides that of the P20 billion first year budget appropriated for AFMA, 10 percent shall be allocated and disbursed for Research and Development, of which 4 percent shall be

used to support the Biotechnology Program. In Rule 83.4 of the IRR for the AFMA, it is provided that the total budget for agriculture and fisheries R & D shall be allocated such that at least 20 percent shall be expended on basic research and not more than 80 percent shall be expended for applied research. It is provided further that biotechnology is considered as basic research and as such the allocation of four percent of the total R&D budget shall be sourced from that portion allocated for basic research.

2. Attaining the principles of the AFMA using biotechnology

The Department intends to use biotechnology as one of the tools to attain the following goals of the AFMA.

Food security and sustainable agriculture – Developing crops through genetic engineering and marker-assisted selection that are tolerant to drought and resistant to pest and diseases would stabilize yields and ensure production. Drought-tolerant crops require less water thereby conserving an increasingly diminishing resource. Insect and disease resistant crops increase yields per unit area thereby giving farmers higher incomes. More importantly, more people will be fed from on the same land area and prevent more land from being harnessed for agriculture. This is crucial, especially since available lands are in environmentally fragile areas like in the uplands. Insect- and disease-resistant crops increases farm profits by reducing chemical pesticide use, saving not only on chemical inputs but also on labor. Early determination of plant sex using molecular markers will ensure higher yields. Local production of DNA vaccines will ensure animal health providing additional income even for farmers in far-flung areas. The use of microorganisms for efficient soil nutrient management will further increase profitability and prevent fertilizer runoffs thereby maintaining the integrity of our open-water systems.

Promoting health and food safety - Developing rice and white corn with added nutritional values like higher iron content through genetic engineering will ensure better nutrition for our people. Another health-promoting advantage expected from pest protected crops is substantial reduction in pesticide residue and aflatoxin in vegetables and grains.

Promoting people empowerment – The DA-BAR has institutionalized the participation of farmers, fisherfolks, and relevant industry representatives to the formulation of R&D programs with the organization of the Farmer Industry Advisory Committee at the national and regional levels. These advisory groups identify major problems to focus R&D efforts and review programs.

3. The development of biotechnology policies at the Department

Biotechnology policies at the Department are formulated by the Office of Policy and Planning with the assistance of the Biotechnology Technical Advisory Group (BioTAG). This group comprise of technical representatives of regulatory agencies of the Department, specifically Bureau of Plant Industry, Bureau of Animal Industry, Bureau of Fisheries and Aquatic Resources, the Bureau of Food and Drug, Department of Health, the Intellectual Property Office, the National Committee on Biosafety of the Philippines and of research agencies such the DA Bureau of Agricultural Research (DA-BAR), IPB-

UPLB, BIOTECH-UPLB, and PhilRice-DA. (The author represents DA-BAR in this committee.) Following is the major biotechnology policy of the Department.

To develop and adopt biotechnology, the Department shall:

- Adopt a program that facilitates rather than limits the development and application of biotechnology, particularly modern biotechnology in Philippine agriculture while ensuring human health, environmental protection and conservation, and equitable sharing of the benefits of our genetic resources.
- Strengthen the capability of the scientific community to undertake development and risk assessment of biotechnology products such as GMOs through aggressive recruitment of appropriately trained individuals, non-degree and degree-oriented training of research staff and provision of adequate facilities and operating funds for continuing research in selected institutions.
- Develop and adopt a transparent regulatory system for the commercialization of GMOs that is science- or product-based rather than technology or process-based. Considering the limited experience the world has today in modern biotechnology products, the regulatory system shall allow for amendments as data and experience come along. Furthermore, acknowledging the great variety in the type and innovation process of biotechnology, the regulatory system shall treat biotechnology products on a case to case basis.
- Promote the initiative of the private sector in the development and commercialization of biotechnology products through a transparent regulatory system and by focusing the public sector efforts in areas unattended to such as technologies for resource-poor farmers
- Promote the wise utilization of Philippine biodiversity by strengthening existing programs of genetic conservation, assessment and characterization of biological diversity and isolation of potentially useful genes

Along this policy, the Department is implementing a program with the following components: policy analysis and advocacy; biotechnology institutional development and capability enhancement; biotechnology research and development; risk analysis; assessment, management, and communication; and biotechnology commercialization. Given the cost of modern biotechnology, we would like to undertake collaboration with countries of mutual interest. Biotechnology is one of the major areas of collaboration agreed upon by the Department of Agriculture, Ministry of Agriculture and Cooperatives, Kingdom of Thailand and the Bureau of Agricultural Research, Department of Agriculture, Government of the Philippines in a Memorandum of Agreement signed early this year.

For further information about the Department of Agriculture, please visit the DA website at www.da.gov.ph.