Tasks in Research, Education and International Collaboration in Agriculture Biotechnology at Kasetsart University With Special Emphasis on the Role of Former Students Who Studied Abroad

Supat Attathom

(Department of Plant Pathology, Kasetsart University, Kamphaengsaen, Nakorn Pathom 73140, Thailand)

Abstract

Thailand is considered as one of the food producing countries of the world. For centuries, Thailand has a large number of skilled farmers engaged in food production. With the increasing demand for agricultural products for export, animal and crop production systems are moving toward high inputs for higher yields. High cost of agricultural production results in less income for farmers and creates an unhealthy environment.

Biotechnology offers a challenge to sustainable bioagriculture production and friendly environment. Some of the key features for biotechnological products are the less use of chemical pesticides, crop varieties that fit the unfavorable environment and crop quality that meets the market needs. Innovation in biotechnology requires a starting point, mainly the university where technology transfer and diffusion can be made available for farmers, general public or industry. This is the case for Thailand where Kasetsart University plays a major role in bioagriculture production.

The development of biotechnology at Kasetsart University was very much in line with the close collaboration between Kasetsart University and the Japanese Government under KU-JICA project since 1980. As a result, the Central Laboratory and Greenhouse Complex (CLGC) was established at Kamphaengsaen Campus. The CLGC is one of the most modernized centers in the region that houses research facilities and well-trained researchers particularly in the area of agriculture biotechnology. In 1985, the Plant Genetic Engineering Unit (PGEU) was established within the CLGC through the collaborative arrangement between Kasetsart University and the National Center for Genetic Engineering and Biotechnology (BIOTEC) of Thailand. This unit focuses on the development of crop varieties for insect and disease resistance by genetic transformation. In 1999 and for the first time, the College of Agriculture offered an undergraduate degree program in Agriculture Biotechnology. During the same period, the Agriculture Biotechnology Center (ABC), Kasetsart University, was established to offer the M.S. and Ph.D. degrees in Agriculture Biotechnology by forming a consortium with four local universities. The Asian Development Bank (ADB) financially supported the program.

From the brief history of human resource development on agriculture biotechnology at Kasetsart University, it is well recognized that international collaboration is essential to success. However, the application aspect of the technology must come from high quality basic research and contribution of well-trained researchers. The outputs of KU-Nagoya collaboration during the past several years have clearly demonstrated the importance of this partnership. International collaboration needs to be strengthened in the future since research institutions like universities will have to attract a group of young, highly qualified scientists to tackle some common issues such as intellectual property rights, biosafety and bioethics. Commercialization of bioagriculture products will be placed under international rules and regulations, which, in many cases, are being used as trade barriers. These tasks are so critical and vital to future development in the area of agriculture biotechnology which can be achieved by close collaboration at national and international levels.

Corresponding author: agrspa@ku.ac.th

Introduction

An increasing demand of food production and the conservation of natural resources greatly affect agricultural systems in many countries including Thailand. In the past, countries producing food crops and other agricultural products have utilized lands and water exhaustively for their productivity and incomes. These common practices resulted in severe deforestation and adverse effects on the environment. Recognizing the potential danger to the global environment, the World Summit of 1992 addressed in the Agenda 21 of the Rio Principles for the sustainable development including "better health care, enhanced food security, improved supplies of portable water, more efficient industrial processes, sustainable methods of afforestation

and reforestation, and detoxification of harzardous waste". This framework of global agreement has several key elements that each country participating in the summit should realize and implement accordingly.

Science and technology, particularly biotechnology, were given high priority to solve the pressing problems facing food production. Therefore, it is an urgent need for human resource development to implement the technology for sustainable development. This is the main challenge of universities and educational institutions to respond to the needs of society by producing graduates and well-trained researchers who are capable of performing their functions with great care and responsibility.

Sustainable Bioproduction: The Thai Perspective

Thailand is considered as one of the food producing countries of the world. The country is the world leader in rice production and export since rice farming has been practiced for over 5,000 years. Thai agriculture has gone through a significant change from subsistence farming to commercial farming. Commercial farming causes the expansion of cultivated land and several detrimental effects on the environment. In addition, the market-oriented agriculture requires high inputs such as chemical fertilizers, pesticides and farm machineries. Farmers will have to rely heavily on the price of their commodities, which in most cases generate less incomes. This kind of trend for non-sustainable bioproduction seems to show clearly in Thailand and other countries in the region.

Sustainable agriculture has been introduced as a new concept for bioproduction. There are varying definitions as to what sustainability in agriculture means. However, most agree on an efficient use of resources that causes as little harm to the environment as possible (Sriwatanapongse, 1997). Recently, the concept of "self-sufficient economy" has been initiated by His Majesty the King of Thailand and now being applied in almost all sectors, especially agricultural production. To be "self-sufficient" in agriculture is to maintain the (wheel of) three factors including the farmer, the environment and the production in a well-balanced way (Fig. 1). This balance will undoubtedly lead to benefit sharing among the concerned factors where "sustainability" clearly reveals itself. As long as we are able to maintain the balance and be competitive, the whole system will certainly move forward to the goal of "sustainable bioproduction".

In terms of sustainable bioproduction, biotechnology offers a new challenge for conventional practices. New generation of biotechnological products should be causing less or no pollutant, consuming less energy and should be safe to consumers. Innovation in biotechnology requires a starting point, mainly the university where technology transfer and diffusion can be made available to the production sector.

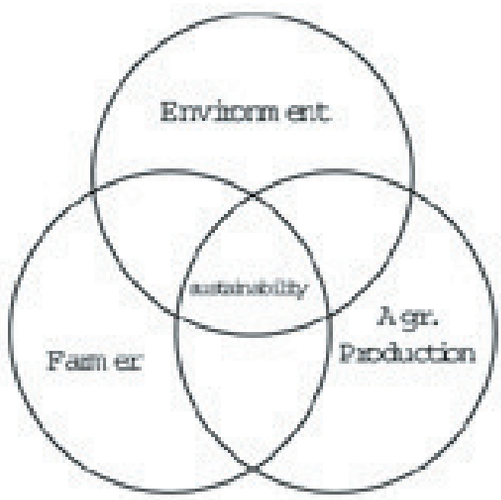

Fig.1 A model of sustainable agricultural production in Thailand.

Research and development in Agriculture Biotechnology

Biotechnology covers a wide range of technologies. It is, therefore, fair to say that agriculture itself is also a part of biotechnology. However, a modern biotechnology generally known as recombinant DNA technology or genetic engineering has emerged recently with so many diverse applications. In the simplest way, a known gene from any living organism can be precisely transferred into plant or animal resulting in so-called "genetically engineered or transgenic" plant or animal. This organism will then express the character of the transferred gene while the overall genotypic characters remain intact. Research and development in agriculture biotechnology, particularly in the tropical

countries like Thailand, are focused mainly on the production of insect, disease and abiotic stress resistant plants (Attathom, 2001). Shelf-life of fruits and vegetables can be prolonged by delaying the ripening process through genetic engineering. Transgenic rice containing vitamin A, which is now being tested in the Philippines is also an example of the improvement of crop nutrition by genetic manipulation.

It is quite clear that biotechnology can lead to the development of crop variety, which depends less on chemical pesticides. This is an advantage for farmers and consumers since chemical pesticides deteriorate the health of farmers, pollute the environment, and contribute to the higher production cost. Products derived from agriculture biotechnology per se thus facilitate sustainable agriculture development.

Agriculture biotechnology as well as molecular biology is developing at fast pace. Biotechnology is now being applied in agriculture in three main areas: animal and crop variety improvement, renewable energy and biodiversity conservation. There are different degrees of complexity in the application of biotechnology in agriculture. For example, the improvement of crop variety may begin with the selection process for the parental lines, the production of pathogen free planting stocks, the development of biofertilizer and biocontrol agents, and the development of genetically-engineered or transgenic plant for specific trait, respectively.

Newly developed agricultural-biotechnology product not only requires technology input and qualified technical staff, but also has to meet the basic requirement in accordance with the international guidelines and regulations as well as consumer acceptance in the global market. In addition, issues concerning intellectual property and biosafety have to be taken into consideration before commercialization of the product can be made (Attathom et. al., 1996). These conditions, on the other hands, are considered to be constraints for the application of biotechnology in agriculture.

Kasetsart University and Agriculture Biotechnology

Kasetsart University (KU), established in 1943, is the country's leading university in agriculture. The university produced a large number of graduates serving in nearly every sector of bioproduction including agriculture, fishery, forestry and agroindustry. Several commercial plant varieties and livestock have been developed at KU by conventional breeding and selection programs. The development of biotechnology at KU was very much in line with the close collaboration between KU and the Japanese Government under KU-JICA project since 1980. As a result, the Central Laboratory and Greenhouse Complex (CLGC) was established at Kamphaengsaen Campus, Nakhon Pathom. The CLGC is one of the most modernized centers in the region that houses research facilities and well-trained researchers particularly in the area of agriculture biotechnology. In 1985, the Plant Genetic Engineering Unit (PGEU) was established within the CLGC through the collaboration arrangement between KU and the National Center for Genetic Engineering and Biotechnology (BIOTEC) of Thailand. This unit focuses on the development of crop varieties for insect and disease resistance by genetic transformation. In 1999 and for the first time, the College of Agriculture offered an undergraduate degree program in Agriculture Biotechnology. During the same period, the Center of Agriculture Biotechnology (CAB), KU, was established to offer the M.S. and Ph.D. degrees in Agriculture Biotechnology by forming a consortium with four local universities. The Asian Development Bank (ADB) financially supported the program. This is the real challenge for the university and the country to mobilize human resource and facilities in agriculture biotechnology for the benefit of the Thai people.

KU-Nagoya U Partnership: An Academic Exchange and Cooperation

From the brief history of human resource development in agriculture biotechnology at KU, it is recognized that international collaboration is an essential component to success. The university always seeks for the opportunity to collaborate with universities and research institutes outside Thailand to strengthen their research and teaching activities. Collaboration between KU and Nagoya University (NU) initiated in 1981 became the classic example of an academic exchange and cooperation among universities in Thailand and Japan. This agreement was continued and subjected to a fourth renewal recently signed by President Thira Sutabutra of KU and President

Minoru Matsuo of NU on May 14, 1999. The newly signed agreement is valid for another five years and renewable before the expiration date.

Within the scope of this agreement, both universities will perform the following activities:

1. Exchange of students by nominating and accepting from time to time students of the faculty of the university to be associated with the host university as a degree/non-degree student for research.
2. Exchange of faculty members and research scholars.
3. Exchange of scientific materials, publication and information.
4. Joint research activities.

Until now, there are a number of staffs, students and researchers from KU who went to NU for their studies and research programs and vice versa. Those who have been trained at NU returned home and contributed significantly in agriculture biotechnology, particularly in crop and animal production. They have organized themselves by forming "The Nagoya University Alumni, Thailand", with 106 members (as of March 2001). This is quite a unique group of scholars that has strong potential to lead the country in research and development in agricultural and social sciences.

Recommendation for Future Collaboration

The long-term relationship of KU and NU shows a successful case of collaboration. Yet, there is still much room for improvement. In my own opinion, there are three areas that need to be focused, namely: the technology assessment, the joint-degree program, and the collaborative R&D projects.

Technology assessment can be done by a group of experts in science, business, law, and economics to evaluate the potential impact of a given technology for the development of Thailand and Japan. The group will have to identify the strengths and weaknesses and other constraints such as the intellectual property issue that could prevent technology to be available to the public. Other dimensions of technology development and application will have to be determined as well. For example, is it better to "buy" a technology than to "develop" it within the country where human resource and know-how are very limited?

The joint-degree program can be implemented immediately since the MS and Ph.D. degrees in agriculture biotechnology at KU have been adjusted into research-oriented degree programs. This system is compatible with most of the degree programs at NU. No course work is required for graduate students who may have language barrier.

The collaborative R&D projects can be initiated in the following areas: agriculture environment, bioenergy and biosafety (Sukondhasingha, 1998). Exchange students and researchers should be part of project activities that lead to common goals. The primary objective of the collaborative project is to produce any product that causes no harmful effect on the environment, uses less or renewable energy and possesses no risk to consumer health. Above all, this is an important step toward the development of sustainable bioproduction.

References

Attathom, S., D. Wongsasithorn and S. Sriwatanapongse. 1996. Biosafety Capacity Building in Thailand. In Virgin V. and R. J. Frederick (eds). Biosafety Capacity Building: Evaluation Criteria Development. SEI, Stockholm. Sweden. p. 59-60.

Attathom. S. 2001. Crop Biotech in Thailand. Global Knowledge Center on Crop Biotechnology Communication and Network Planing Workshop. 11-13 January 2001. Siam City Hotel, Bangkok, Thailand.

Sriwatanapongse, S. 1997. The Role of Science and Technology in Thailand's Agricultural Sector. In Yuthavong Y. and A.M. Wojcik (eds). Science and Technology in Thailand: Lessons from a Developing Economy. NSTDA/UNESCO Publishing. p. 45-71.

Sukondhasingha, K.1998. Foresighting in the Thai Private Sector. In Application of Technology Foresight. NSTDA, Thailand. p. 91.