Expert Consultation on Agricultural Biotechnology, Biosafety and Biosecurity

27-28 October, 2011

PROCEEDINGS AND RECOMMENDATIONS

Organized by

Asia-Pacific Association of Agricultural Research Institutions (APAARI)
Asia-Pacific Consortium on Agricultural Biotechnology (APCoAB)
Council of Agriculture (COA), Chinese Taipei
Taiwan Agricultural Research Institute (TARI), Chinese Taipei

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Foreword

The new and emerging biotechnological research advances, transboundary disease and pest movement, and climate change are likely to have profound impact on plant and animal health and consequently human welfare. Advances in genetic engineering leading to release of modified crops like Bt cotton and Bt corn have brought significant improvements in productivity, reduced the use of pesticides and increased farmers' income. However, GMOs require proper handling and field management due to concerns about their safety to health and environment.

The liberalization of global trade in recent years has opened new avenues for growth and diversification of agriculture. But it has also increased the risk of introduction of exotic pests and weeds with the potential to cause serious economic losses. Climate change has the potential to alter the habitat of known pests and even help introduction of new pests. The emergence and spread of transboundary diseases such as the avian influenza and Ug-99 wheat stem rust pose new threats to human and plant safety. Also, there is a need to contend with the ever increasing threat of bio-terrorism. It is because of these concerns that agricultural biosecurity has emerged as a serious issue requiring policies and technological capabilities to prevent, detect, and respond to such threats.

While appreciating its biosafety risks, biotechnology offers means to enhance biosecurity. Animal diseases are controlled by biotechnologically developed vaccines while ELISA and PCR enable quick and reliable diagnosis of diseases in plants and animals. Genetically modified crops would safeguard against the spread of new diseases and pests, and thus serve as a first line of defense.

In view of the above mentioned biotechnology and biosecurity issues to ensure food and nutritional security, the Asia-Pacific Association of Agricultural Research Institutions in collaboration with Council of Agriculture, Chinese Taipei organized an "Expert Consultation on Agricultural Biotechnology, Biosafety and Biosecurity" in Taichung on 27-28 October 2011. The objective was to review the present status of biotechnology and biosafety adoption in the Asia-Pacific countries, to suggest approaches to improved application of biotechnology, biosafety and biosecurity for agriculture, and develop strategies for regional cooperation in these areas. We are glad to note that the meeting evoked excellent response with participation of 73 invitees from 22 countries of Asia, the Pacific, Australia, Africa and North America. The participants included international experts and leaders from APAARI member NARS and CG centers, representatives of industry, civil society organizations and farmer groups. We appreciate the support of Global Forum on Agricultural Research (GFAR), Taiwan Agricultural Research Institute (TARI), AVRDC- The World Vegetable Center, IRRI, CIMMYT, CABI and staff of APAARI, COA and TARI in organizing this meeting. It is our hope that the recommendations will stimulate action for development of comprehensive agricultural biosecurity systems at the national and regional levels, while taking advantage of available tools of modern biotechnology.

Su-San Chang **Raj Paroda**

ACRONYMS and ABBREVIATIONS

ABSP II	Agricultural Biotechnology Support Program II
AIA	Advanced Informed Agreement
APAARI	Asia-Pacific Association of Agricultural Research Institutions
APCoAB	Asia-Pacific Consortium on Agricultural Biotechnology
AVRDC	The World Vegetable Center
BCH	Biosafety Clearing House
Bt	Bacillus thuringiensis
CAC	Codex Alimentarius Commission
CBD	Convention on Biological Diversity
COA	Council of Agriculture (Chinese Taipei)
Codex	Codex Alimentarius Commission
CPB	Cartagena Protocol on Biosafety
DNA	Deoxyribonucleic acid
EC	European Commission
EMPRES	Emergency Prevention System of FAO
EPA	Environment Protection Act
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FARA	Forum for Agriculture Research in Africa
FDA	Food and Drug Administration
FFP	Food, feed and processing
GE	Genetic engineering
GM	Genetically modified, genetic modification
GMOs	Genetically Modified Organisms
GT	Gene Technology
GURT	Genetic use restriction technology
HIV	Human Immunodeficiency Virus
HT	Herbicide tolerance
IBSC/IBC	Institutional Biosafety Committee
IPPC	International Plant Protection Convention
IPR	Intellectual Property Rights

ISPM	International Standard for Phytosanitary Measures
LMOs	Living Modified Organisms
MARDI	Malaysian Agricultural Research and Development Institute
mha	Million hectares
MNC	Multi National Company
MOSTI	Ministry of Science, Technology and Innovation (Malaysia)
mRNA	Messenger RNA
NARC	Nepal Agricultural Research Council
NARI	National Agricultural Research Institute (Papua New Guinea)
NBCP	National Biosafety Committee of the Philippines
NBF	National Biosafety Framework
NCBP	National Committee on Biosafety in the Philippines
NIH	National Institute of Health
OECD	Organization of Economic Cooperation and Development
OIE	World Organization for Animal Health
PCAARRD	Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development
PCR	Polymerase chain reaction
PHES	Potentially harmful exotic species
PPP	Public Private Partnership
PRA	Pest risk analysis
PTTC	Platform for Translational Research on Transgenic Crops
RAC	Recombinant Advisory Committee
rDNA	Recombinant DNA
SABIMA	Strengthening Capacity for Safe Biotechnology Management in sub-Sahara Africa
SPS	Sanitary and Phytosanitary
TADs	Transboundary animal diseases
TARI	Taiwan Agricultural Research Institute (Chinese Taipei)
TRIPs	Trade Related Intellectual Property Rights
TYLCV	*Tomato yellow leaf curl virus*
UNCED	UN Conference on Environment and Development
UNEP-GEF	United Nations Environment Programme – Global Environment Fund
US	United States
VAAS	Vietnam Academy of Agricultural Sciences
WHO	World Health Organization
WTO	World Trade Organization

Expert Consultation on Agricultural Biotechnology, Biosafety and Biosecurity

Taiwan Agricultural Research Institute (TARI)
Taichung, Chinese Taipei
27-28 October, 2011

Background

The "Green Revolution" of 1970s and 1980s saw several Asia-Pacific countries making substantial progress in enhancing crop productivity, which led to greater availability of food, higher farm incomes and improved human development. However, emerging challenges to agricultural growth have renewed concerns about food security, poverty and hunger. The last few years have seen a slow down or even stagnation in crop productivity leading to alarmingly low grain reserves and spiraling food prices. Along with, increasing diversion of food grains for livestock feed and biofuels, and relentless growth in population of some countries is adding to the already difficult food situation. Under the prevailing conditions, most of the developing countries of the region will not be able to meet the Millennium Development Goals of halving poverty and hunger by 2015. Accordingly, there is an obvious call for the second "green revolution" the technological component of which would be driven by new biology, especially biotechnology.

GM technology is globally recognized as a powerful means of improving productivity, profitability and sustainability of farm production systems, including those of small farm holdings. Since the first farm level cultivation of GM crops in 1996, the global area under these reached 148 million hectares (mha) in 2011 with 29 countries growing them. In India, the area under Bt cotton has reached a staggering 9.4 mha in just 8 years since its first release, comprising nearly 86% of the total 11 mha cotton area. Bt maize in the Philippines, grown for the first time in 2003, covered an area of 0.5 mha in 2010. In China, GM cotton, papaya, tomato, sweet pepper and poplar are being grown over 3.5 mha while approval was granted in 2009 to GM rice and maize. GM fish and cloned animals are being pushed for commercial farming. Several studies made on the performance and impact of GM crops in India and China have shown that farmers, irrespective of their farm size, have benefited through increased yield and reduced pesticide use which have converted into higher profits and increased household incomes as well as increased aggregate employment.

Several developing countries of Asia-Pacific support significant programs on GM-based crop improvement in a wide range of crops and some have made policy statements asserting biotechnology as being integral to priority planning for agriculture and national development. However, few have been able to follow a policy of steady support to GM technology. Most countries of the Asia-Pacific have adopted precautionary principle towards biosafety risk assessment and management in conformity with the Cartagena Protocol on Biosafety and have developed their

regulatory systems accordingly. However, practical implementation of the biosafety regulations has often been hampered by lack of preparedness in terms of infrastructure and capacity, as well as due to social, economic and political reasons. Perceived and often unsubstantiated adverse environmental and health risks of GM technology have influenced public opinion and decision making, thus delaying the adoption of promising technologies that could address sustainability issues. The need to base regulatory decisions on sound science and creating public awareness was duly highlighted in "Expert Consultation on Agricultural Biotechnology for Promoting Food Security in Developing Countries" organized by APAARI in 2008.

Biotechnology has other important implications on the recently emerging concerns about biosecurity. The prevention and control of alien agricultural pests is now assuming urgency due to increasing international travel and trade in food and other agricultural products, and fears of deliberate spread of diseases and pests with the purpose of compromising food security of nations. Biosecurity in its broad sense is a strategic and integrated approach that encompasses the policy and regulatory frameworks for analyzing and managing relevant risks to human, animal and plant life and health and associated risks to environment. Biotechnological techniques like ELISA and PCR have vastly improved disease diagnostics and surveillance in animals and plants. Recombinant vaccines are superior to conventional vaccines in terms of specificity and safety.

Traditionally, biosecurity is managed at the national level on sectoral basis with sector related agencies developing individual policies and implementing them. However, need is being expressed for a more holistic approach involving harmonization and integration to ensure effective prevention and control of biosecurity threats, including those related to biotechnology. Integration encompasses the joint setting of priorities and allocation of resources, joint planning and implementation of activities, and integrated systems for monitoring and review of outcomes. Such an approach would also make biosecurity implementation more affordable, a concern of several developing countries. In addition, in view of increasing trade and transboundary movement of biological materials including food, there is a need for regional cooperation and harmonization of approaches to achieve desired levels of safety without creating unnecessary barriers.

Keeping in view the abovementioned needs, the Steering Committee of Asia-Pacific Consortium on Agricultural Biotechnology (APCoAB), a program of APAARI, in its meeting held on 14 January 2011 recommended organizing an Expert Consultation on Biotechnology, Biosafety and Biosecurity in Chinese Taipei, as a part of the ongoing APAARI-Council of Agriculture, Chinese Taipei (COA) collaborative program. The meeting was held at Taiwan Agricultural Research Institute (TARI), Taichung on 27–28 October 2011.

Objectives of the Expert Consultation

1. Review the status of biotechnology and biosafety adoption in the Asia-Pacific countries;
2. Identify priority areas and actions for effective implementation of biotechnology, biosafety and biosecurity for agriculture and food security;
3. Suggest approaches to regional cooperation in biotechnology and biosafety in the context of biosecurity.

Inaugural Session

The Opening Session was Chaired by Dr. Junne-Jih Chen, Director General, Taiwan Agricultural Research Institute (TARI), Council of Agriculture, Chinese Taipei. Dr. Raj Paroda, Executive Secretary, APAARI and Dr. Su-San Chang, Director General, International Cooperation Department, Council of Agriculture, Chinese Taipei (on behalf of the Hon'ble Minister of Agriculture) made welcome remarks as joint organizers of the Expert Consultation.

While welcoming the participants, Dr. Raj Paroda emphasized on the increasing importance of the topic in the context of present need for food and nutrition security along with security from agricultural diseases, pests and alien invasive species. The increasing population, particularly in the developing countries, necessitates improvement in productivity of agricultural systems, including animals and fisheries, adoption of modern genetic improvement technologies and efficient farm management. Biotechnology has the potential to raise farm output and enhance farmers' incomes, including those of small and marginal farmers, as has been experienced by some Asian countries. The adoption needs to be up-scaled in order to improve the livelihood of small and marginal farmers. Dr. Paroda also mentioned that biosafety issues related to GM technology are assuming greater importance in many countries, including those in Asia and the Pacific. He said that there is a need to address genuine environmental issues while generating science-based public awareness. There is a similar need to develop adequate infrastructure and capacity to meet other biosecurity threats to agriculture, like outbreaks and transboundary movement of serious diseases and pests. The emergence of some diseases of crops and farm animals as global biosecurity risks calls for international cooperation in controlling and eradicating them.

Dr. Junne-Jih Chen in his opening address warmly welcomed all the participants to the TARI campus. He highlighted the significant breakthroughs made in many developed countries through the use of agricultural biotechnology, such as, the development of transgenic corn, cotton and canola, resulting in higher yields and better resistance to pests. He said that the progress in research and application of agricultural biotechnology in the Asia and Pacific region was relatively slow, and, hence, the benefits of such an advanced technology have not yet been appreciated by the majority of farmers as well as general public. He informed about the various TARI programs on agricultural biotechnology R&D including infrastructural facilities and parks, one of which was located at TARI. He also emphasized on the issue of biosecurity which have become important in recent years due to increased international trade in agricultural produces. The urgent and critical need to prevent and control invasive species, including pests, diseases, animals and plants required cooperation within the Asia-Pacific region without creating unnecessary barriers to international trade.

Dr. Su-San Chang read the message from the Hon'ble Minister of Agriculture who was unable to attend the opening session. His message highlighted the problems in agricultural growth such as soil erosion, dwindling water resources, global warming, and population expansion. Hence, the greatest challenge for the present day agriculture is to produce more food with higher efficiency, yet with minimum environmental impact. Biotechnology is a very promising tool to deal with these emerging challenges. The improved productivity and nutritional value of crops brought about by the latest developments in genetic engineering and molecular marker-assisted breeding would have a positive effect in alleviating the food crisis and combating climate change. The Hon'ble minister informed about multidisciplinary biotechnology-based

research programs undertaken in Chinese Taipei in recent years and the efforts in addressing the biosafety related issues of GM crops. The importance of biosecurity in transboundary movement and trade in crops or products both GM and non-GM was also highlighted. He hoped that the Expert Consultation would provide a platform to the participants to exchange opinions and suggest approaches to regional cooperation in biotechnology, biosafety and biosecurity in the Asia-Pacific region.

Dr. J. L. Karihaloo, Coordinator APCoAB proposed the vote of thanks to conclude the opening session.

Session I: Biotechnology, Biosafety and Biosecurity R&D in Asia-Pacific – Country Status

This session was Chaired by Dr. Dyno Keatinge, Director General, The World Vegetable Center, Chinese Taipei and Co-chaired by Dr. Su-San Chang, Director General, International Cooperation Department, Council of Agriculture, Chinese Taipei.

Status of Agricultural Biotechnology, Biosafety and Biosecurity in India – R.K. Khetarpal*

The presentation highlighted the rapidly transforming India's agricultural biotechnology scenario with its well established framework for regulation of genetically modified (GM) crops. The import of plants (including transgenics) in India is governed by the Plant Quarantine (Regulation of Import into India) Order 2003 under the Directorate of Plant Protection Quarantine and Storage which operates through a network of 35 plant quarantine stations under the Ministry of Agriculture. Attempts are made to comply with International Standards on Plant Protection as per SPS/ WTO norms. The regulations of import and export of livestock and livestock products, control of exotic diseases and certification as per World Organization for Animal Health (OIE) regulations are carried out through the Animal Quarantine and Certification Services, under the Department of Animal Husbandry and Dairy, located at New Delhi, Kolkata, Chennai and Mumbai. India has well-developed laboratories and manpower in the field of plant and animal sciences but they are scattered and have limited interaction to collectively address common issues. There is a need to work in a networking mode for diagnostics and control of diseases/ pests in cases of emergency. The establishment of a National Agricultural Biosecurity System comprising a network of institutes to deal with plants, animals and living aquatic resources is also being initiated.

Status of Agricultural Biotechnology, Biosafety and Biosecurity in Malaysia – Abd Shukor Abd Rahman and Umi Kalsom Abu Bakar*

The presentation focused on the development in agricultural biotechnology for the application of GM technology in local crop improvement. Transformation systems have been developed for rice, papaya, banana, pineapple, citrus, mangosteen, passion fruit, orchids, oil palm, rubber and forest species as an initial step to producing GM crop varieties with high quality and resistant to pests and diseases. For improvement of livestock production, advanced reproductive biotechnology is being adopted and further enhanced by the recent establishment of the National Animal Embryo

*Presenting author

Centre at MARDI. R&D in the frontier areas such as functional genomics, metabolomics and bioinformatics on crops, livestock and microbes are also being actively conducted to generate fundamental knowledge and understanding and till date, oil palm and rubber plant genomes have been fully sequenced. To fulfill Malaysia's obligation under the Cartagena Protocol on Biosafety for a national legal instrument to regulate the release, importation, exportation and contained use of living modified organisms derived from modern biotechnology and products of such organisms, the Malaysian Biosafety Act 2007 was passed in the Parliament in July 2007 and came into force on 1st December 2009. However, biosecurity is relatively new in the country. Realizing its growing importance, the Ministry of Science, Technology and Innovation (MOSTI) will spearhead a five year national R&D program on bio-surveillance with the goal to enhance the existing R&D in bio-diagnostics and biosensors in food, medical and agriculture for effective bio-surveillance. The short-term goal is also to develop a mobile bio-surveillance unit of Biosafety Level (BSL) 3 for effective early warning and on-site identification of biological threats. It is planned to have a comprehensive biosecurity system in Malaysia like that of some other countries in the region.

Status of Agricultural Biotechnology, Biosafety and Biosecurity in Nepal – Dinesh Pariyar*, Y.P. Giri, B.P. Sah and H.K. Manandhar

The paper highlighted Nepal's agricultural biotechnology, biosafety and biosecurity policies which are based on conservation and protection of biodiversity and indigenous agricultural system, and regulation in GMO, LMO and quarantine pests. Nepal has signed Cartagena Protocol in 2002 and a number of biosafety-related policies, plans and strategies have been prepared. Also, over 17 Acts, which are related to biosafety and biosecurity, including Plant Protection Act, 1972; Seed Act, 1989; Food Act, 1966; Animal Health and Livestock Service Act, 1998 are in place. A framework for biosafety and biosecurity for the country has been worked out. In case of biotechnology, Nepal Agricultural Research Council (NARC) established Biotechnology Unit during 1997 realizing the importance of traditional as well as modern biotechnology to facilitate plant and animal breeding programs. NARC research experiences on biotechnology have shown that integration of plant tissue culture and molecular marker technology in mainstream breeding work is a very relevant approach to take advantages of biotechnology in developing countries like Nepal. It was emphasized that there is an urgent need to initiate biotechnology R&D work through establishing strong international collaboration in those commodities where traditional technology is ineffective or inefficient in minimizing the adverse effect of rapidly changing climate.

Status of Agricultural Biotechnology, Biosafety and Biosecurity in Philippines – Patricio S. Faylon*

The presentation covered the role of agricultural biotechnology in improving crops, livestock production and forest ecological functions in order to respond to the impacts of climate change, deal with critical issues and develop mitigative strategies. The Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) has supported biotechnology through R&D funding and provision of enabling policies and facility enhancement and manpower development. For crop improvement, employment of biotechnology tools is geared towards insect pest and disease resistance, delayed ripening characteristics, optimization of tissue culture techniques and protocols, development of diagnostic kits and cloning of economically important genes. The status of these undertakings varies from laboratory level to field-testing. The

Philippines has a functional biosafety regulatory system and a robust science-based assessment. The National Committee on Biosafety in the Philippines (NCBP) is commissioned to identify the potential hazards posed by experiments on genetic engineering and recommend measures to minimize risks. Further, the National Biosafety Framework of 2006 strengthens the NCBP by coordinating and harmonizing the inter-agency and multi-sector efforts.

Status and Future Perspectives in Agriculture Biotechnology, Biosafety and Biosecurity in Sri Lanka – Malliywadu Trixie Kumudini Gunasekare*

The presentation highlighted the strong agriculture focus in Sri Lanka through its 10-year comprehensive national development program (2006-2016) with the goal of ensuring food security and improving income for farmers. The country recognized the use of novel technologies as a driving force in increasing productivity and to address numerous challenges faced by the farmers. R&D in biotechnology is one of the key areas for agriculture development. More emphasis is being placed on molecular based (non-transgenic) techniques even though genetic engineering has progressed to some extent. No commercialization of GM crops or animals has taken place so far. Setting up of an enabling environment to conduct R&D in biotechnology has lagged behind over the years owing to the absence of needs identification and priority setting at the national level. However, the recently formulated five year plan on National Biotechnology R&D program and an Investment Plan offer clear directions and priorities for proper decision making while rationalizing resource utilization. Sri Lanka ratified Cartagena Protocol of the CBD in 2004 and had formulated the National Biosafety Policy and established a Biosafety Clearing-House while facilitating to set up accredited laboratories for GMO testing and detection. For ensuring biosecurity, Sri Lanka has several sectoral acts on plant protection, plant quarantine, wild life, fisheries etc., which are relevant to biosafety and biosecurity.

Status of Agricultural Biotechnology, Biosafety and Biosecurity in Chinese Taipei – Kuo-Yun Fang*

The presentation highlighted the Chinese Taipei policy to promote agricultural R&D by employing biotechnology and efficient management of biosafety and biosecurity issues. The Council of Agriculture (COA) has specified main research in the areas of plant seedling, aquaculture, livestock, food, bio-fertilizer, bio-pesticide, animal vaccine, and testing and diagnostics. Several projects on promotion of the quality agricultural products, development of pest-resistant GM crops to reduce the use of chemical pesticides, production of GM organisms with ornamental value such as fluorescent fish, development of GM pigs for organ transplanting, development of model animals for biomedical research, and use of bioreactor technology for producing vaccines, growth factors and coagulation factor, etc are in progress or have been successfully completed. The COA has also proposed a strategic framework for industrialization, on the basis of Chinese Taipei's current agricultural advantages and future development opportunities, to integrate the agricultural biotechnology and the industry's R&D capacities. The major concerns about developing GMOs are the possible transfer of the engineered gene(s) into related species or wild populations, the effect on non-target organisms (e.g. insects which are not pests), and the reduction in the spectrum of other plants (loss of biodiversity). For the management of GMOs, the country has established regulatory system to ensure biosafety and biosecurity. A science-based assessment has been established to evaluate the characteristics of the GMOs and their effect and stability in the environment, and to determine the unintended effects resulting from the transgenic organisms.

Vietnam Policies on Biotechnology and Biosafety Development and Application – Vu Manh Hai*

The presentation covered the various programs launched by the government for sustainable development of agriculture-forestry-fisheries, environment protection and healthcare including the 2001-2010 Program of Biotechnology Research and Development (KC04). Vietnam has also paid great attention to the biosafety concerning which several legal documents have recently been approved by the government. Biosafety system is also clearly defined in terms of functions and responsibilities of the institutions under the Food Safety Law approved on 17 June 2010. These cover the import requirements, quality parameters, packaging, preservation and labelling. The presentation also brought out the limitations such as lack of understanding of biosafety among scientists and media, limited trained and experienced personnel, limited resources and institutional capacity in risk assessment.

Discussion Points

- Dr. Francis Ogbonnaya, ICARDA advocated information sharing on biotechnological developments including marker aided selection among countries and public and private sectors. Examples of African countries where such information sharing has taken place and benefited all the partners were quoted. Dr. Simon Hearn gave the example of collaborations between India (ICAR) and Australia on marker aided selection for crop improvement.
- APAARI could provide a platform for discussions on information, material and technology sharing, specifically in the Asia-Pacific region.
- Transboundary movement of pests and diseases is a very real threat to biosecurity in the region for which early warning systems need to be in place to take necessary emergency action. Work on biosensors for early detection and information technology to monitor movement of the pests to be intensified.
- Extensive survey and surveillance system backed by good diagnostic capabilities is the backbone of a good biosecurity system. Sharing of the resources and technologies developed within the APAARI family needs to be encouraged. APAARI could bring the respective countries together, creating awareness and exploring mechanisms to deal with this issue.
- Dr. Walter S. Alhassan highlighted the pre-emptive action taken by east Africa, especially Uganda on the Ug99 race of wheat rust and the *Cassava mosaic virus* Ugandan race.
- It was suggested to approach the Emergency Prevention System (EMPRES) for transboundary animal and plant pests and diseases of FAO for transboundary pest/disease outbreaks in the epidemic form to help nations deal with emergency situations.
- Dr. Raj Paroda highlighted the deficiencies of public sector systems due to which they are unable to deliver GM products despite huge investments, which has lead to monopoly of MNCs.
- Dr. Raghunath Ghodake highlighted the benefits of GM technology and the need to take case by case decisions on biosafety risk assessment and management.

Session II: Biotechnology, Biosafety and Biosecurity R&D – Regional Status

The session was Chaired by Dr. Abd Shukor Abd Rahman, Director-General, Malaysian Agricultural Research and Development Institute (MARDI), Malaysia and co-chaired by Mr. Mason Smith, Permanent Secretary for Agriculture, Department of Agriculture, Ministry of Primary Industries, Fiji.

Status of Biotechnology, Biosafety and Biosecurity in the Pacific Region – Toshiro Shigaki and Raghunath Ghodake*

The presentation highlighted the potential of innovation in agricultural, medical and environmental research to benefit economies and welfare of the people in the region. On the other hand, biotechnology raises biosafety and biosecurity issues that were not envisioned in the past. The current status and development in the areas of biotechnology, biosafety and biosecurity in the Pacific Region was highlighted. For the 22 Pacific countries including 8 dependent territories with a total population of 13 million and covering vast and scattered areas, it is a challenge to adopt biotechnology and implement updated biosafety and biosecurity measures.. Most countries in the region do not have the capacity to perform research in biotechnology, mainly due to the lack of human talent, infrastructure and financial resources. Fourteen Pacific countries have ratified the Cartagena Protocol, and submitted drafts of National Biosafety Framework to CBD. However, local legislations that are required for its implementation have been slow to come by. As a result, there is no proper regulation concerning LMOs which pose continued biosecurity risks. Capacity building for biotechnology and biosafety is under progress in some Pacific countries. However, strict, efficient and immediate implementation of Cartagena Protocol is necessary regardless of the varying levels of capacity development. Such actions would streamline commerce and encourage collaborative research with the rest of the world, and contribute to improved food security and welfare in the region.

Agricultural Biotechnology, Biosafety and Biosecurity in Africa – Walter S. Alhassan*

The presentation recounted the gradual building of the legal framework and the technological capacity to harness modern biotechnology for their agriculture by the African countries. A 2010 survey report by FARA on sub-Sahara Africa excluding South Africa revealed that Burkina Faso, Ghana, Kenya, Nigeria, Uganda and International Centers had the largest number of institutions engaged in biotechnology research activities. Three African countries (Burkina Faso, Egypt and South Africa) are in commercial GM crop production and at least 14 have the legal framework to be able to conduct confined field trials on GM crops, but only six are engaged in it. The absence of enabling environment was mostly a result of lack of capacity for GE policy-making. Six African countries operating at least at the confined field trial stage are receiving training under the Forum for Agriculture Research in Africa (FARA)'s project on strengthening capacity for safe biotechnology management in sub-Sahara Africa (SABIMA) in biotechnology stewardship and its application to GM crop development and use. Biosecurity as a component of general biosafety activities and harmonization of such activities across state agencies within a country and in the region is not practiced.

Status of Agricultural Biotechnology, Biosafety and Biosecurity in Asia – J.L. Karihaloo* and Kavita Gupta

The presentation elaborated the high priority to agricultural biotechnology being given by countries of Asia. Nearly a dozen countries have ongoing programs on biotechnology R&D. More than

50 crops and forestry trees are being targeted for genetic modification for diverse traits, most prominent among which are resistance to diseases and pests, and abiotic stress tolerance. Most of these researches are in laboratory or greenhouse phase while some are in advanced field trial phase. China, India, the Philippines and Pakistan, which have released GM crops, have in general experienced benefits through increased yields, fewer applications of pesticides and higher farmers' income. With respect to adoption of biosafety systems, most countries are party to or have ratified the Cartagena Protocol on Biosafety. In several, biosafety regulatory systems in the form of framework, laws, regulations, rules and guidelines have been developed while in a few these are operational. Highly virulent Ug99 race of wheat stem rust, *Maize streak virus*, *Bromus secalinus* (a noxious weed), *Brontispa lonissima* (coconut beetle) and Avian influenza are some of the biosecurity threats that could cause severe loss to agricultural economy of this region. Biotechnological tool are being used for disease surveillance in China and Japan. Pest and disease resistant crops can be used for post-border biosecurity thereby reducing the pests' effects on agricultural systems. However, biotechnological tools to strengthen biosecurity through rapid and accurate detection of quarantine pests and diseases, and surveillance remain mostly underutilized. Agricultural biotechnology in all countries, except a few, faces challenges of limited funding, infrastructure, technical and regulatory capacity. Biosecurity is mostly managed on a sectoral basis through separate policy and legislative frameworks (e.g. for animal and plant life and health).

Discussion Points:

- Dr. Simon Hearn highlighted the Pacific region cooperation for compliance to the scientific aspects of the SPS Agreement of the WTO. Cooperating countries will promote capacity development on risk assessment and quarantine aspects of the Agreement, especially to promote exports from the region.
- Dr. R.K. Khetarpal opined that the lack of legal instruments for compliance to the SPS Agreement in the Pacific countries could be addressed through FAO funded TCP projects on capacity development to harmonize the legal provisions in the region in tune with the Agreement.
- Listing of pests occurring in the region and their classification based on the identified risk levels would be the first step, and bringing them under the legal framework would be the next step towards harmonization of norms at the regional level. Appropriate level of protection (ALP) as described under the SPS Agreement needs to be determined with caution as presently there are no guidelines in this regard.
- The limited scientific information available on various biosafety issues including the rationale of recommended refugia norms was pointed out. It was agreed that substantially more data needs to be developed in these areas.
- The determination of reasonable risk in release and use of GM products needs to be dealt case to case and country to country. Affordability of the GM technology by the countries needs to be assessed before venturing into such expensive endeavors.
- Micronutrient enhancement through deployment of GM technology to be taken up only after ensuring that the soil health is sound was emphasized by Dr. Suman Sahai.
- Need to strengthen regional linkages especially with institutions having a strong capacity in biotechnology, regulatory and IPR issues. APPARI should continue to work as a facilitator for FAO sponsored programs on biosafety regulatory systems.

- Liability and redress as stipulated under the Cartagena Protocol to be addressed in proper perspective, especially during transboundary movement of transgenics.

Session III: Advances in Biotechnology for Food Security

The session was Chaired by Dr. Thomas Lumpkin, Director General, CIMMYT, Mexico and co-chaired by Dr. R.D. Ghodake, Director General, National Agricultural Research Institute (NARI), Papua New Guinea.

Contribution of Biotechnology to Stress-tolerant Vegetable Crops – Roland Schafleitner* and Chen Huei-mei

The presentation highlighted the role of biotechnology in developing stress-tolerant crops by marker-assisted breeding through the introgression of tolerance traits from wild relatives or germplasm into cultivated varieties, and genetic engineering. It outlined the contribution of biotechnology in the development of tomato plants resistant to *Tomato yellow leaf curl virus* (TYLCV), one of the most devastating diseases of this crop. Resistance genes against TYLCV were identified in wild tomato and were successfully introduced into elite varieties. Marker-assisted breeding fostered host resistance through pyramiding several different resistance genes in one line, and largely facilitated early generation selection of resistant plants, resulting in the restoration of tomato production in TYLCV-affected areas. The second approach to obtain TYLCV-resistant plants is based on transgenic expression of fragments of the TYLCV genome causing RNAi-mediated silencing of TYLCV genes upon infection. Testing of several different TYLCV gene fragments revealed that the C1 and C2 gene region of TYLCV is most promising to induce RNAi-mediated resistance against the virus. Multiple C1/C2 gene fragments derived from different viral strains can be expressed simultaneously in one plant to extend resistance to a broader range of viral strains. A comparison of both methods showed that the genetic engineering approach consumed less time and resources than resistance gene introgression from wild relatives through breeding. However, the regulatory framework for genetically engineered crops might nullify the cost and time advantage of the transgenic approach before commercialization.

Development of Genetic Engineering Technology Aimed to Produce Crops Tolerant to Environmental Stresses – Kazuo Nakashima* and Kazuko Yamaguchi-Shinozaki

The presentation covered the work done on the molecular mechanisms of environmental stress tolerance of plants using *Arabidopsis* and rice. It was found that stress-responsive transcription factors such as DREB, AREB, and NAC have important roles for stress response and tolerance in plants. It has been shown that the over-expression of the stress-responsive transcription factors such as DREB can improve tolerance to a wide range of environmental stresses including drought and high salinity. Presently, international joint research is being conducted to introduce stress-tolerant genes into important crops, produce stress-tolerant lines, and examine stress-tolerance in fields. Stress-tolerant genes combined with stress-inducible promoters have been sent to IRRI, CIAT, CIMMYT, and Embrapa, Brazil to produce transgenic rice, wheat, and soybean lines tolerant to environmental stresses. By developing crops tolerant to environmental stresses through international collaboration. It is aimed to reduce agricultural damage and ensure stable yield in many parts of the world, especially in the developing regions.

Biotechnology: An Imperative for Sustainable Food Production – Francis C. Ogbonnaya*, Michael Baum and Mahmoud Sohl

ICARDA holds more than 135,000 germplasm accessions in its genebank, including large collections of landraces and wild relatives which provide the genetic resources essential for achieving higher and stable gains in yields and quality. This coupled with rapid advances in sequencing technology have opened new possibilities for using genomic information in breeding, providing tools that permit far more rapid and comprehensive analysis of these resources and their potential for use in improving the productivity of food crops. A major example of such introgression is the use of wild *Triticum* and *Aegilops* species, which has enlarged the genetic base of bread wheat and provided access to novel sources of resistance to drought, rusts, *Septoria*, Russian wheat aphid, Sunn pest and Hessian fly, and the identification of promising lines in wheat for higher yields under optimum and drought conditions. Molecular markers tightly linked to agronomically important traits have been identified in wheat, barley, chickpea and lentil. These developments have made it possible, using marker-assisted selection (MAS), to rapidly and precisely transfer the desirable genes between genotypes and to introgress the novel genes into elite germplasm from wild species without noticeable linkage drag. Further, genome-wide association studies in wheat and barley at ICARDA have facilitated mapping, greater understanding of the genetic bases, and gene mining of complex traits including yield, yield stability, drought adaptation and some of the underlying physiological traits and disease resistance. ICARDA has identified DArT markers with significant association to grain yield across diverse environments which could be used to efficiently pyramid multiple loci associated with increased yield into locally adapted varieties through marker-assisted backcrossing or marker-assisted recurrent selection. At ICARDA, transformation events in wheat, lentil and chickpea have been demonstrated successfully and established protocols are available for barley, which open a new vista in genetic improvement of these crops. Other important interventions used by ICARDA, that compliment conventional breeding include tissue culture techniques, such as doubled haploid production in barley and wheat; and the exploitation of *in vitro* selection and somaclonal variation, for example, in the development of grass pea germplasm with lower ODAP-neurotoxin content.

Discussion Points:

- More emphasis should be laid on molecular assisted breeding than on development of transgenics since the latter involves lengthy and expensive biosafety assessment.
- AVRDC has a portfolio of techniques that could be applied selectively on the basis of target crops and the traits of interest. However, both molecular as well as transgenic approach works for breeding virus resistant tomato.
- The importance of DREB gene in developing drought tolerant crops is well appreciated. The possibility of sharing this gene for public good needs to be explored.

Session IV: Advances in Biosafety and Biosecurity

The session was Chaired by Dr. N.P. Eleazar, Director, Bureau of Agricultural Research, Department of Agriculture, Philippines and co-chaired by Dr. Dinesh Pariyar, Nepal Agricultural Research Council, Nepal.

Biosecurity in Asia Pacific: Status and Future – R.K. Khetarpal* and Kavya Dashora

The presentation highlighted the importance of agricultural biosecurity in Asia-Pacific which faces serious threats with a number of transboundary pests threatening the food security and animal and human health in the region. Regional cooperation and coordination are critical in reducing the impact of trans-boundary pests and diseases. Various organizations are committed to play a major role in strengthening the regional plant protection system. FAO's Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) provides support to governments in all of these areas. The International Plant Protection Convention (IPPC) with Secretariat at FAO has a strong presence in each of the FAO regions, and the Regional Office for Asia and the Pacific provides the Secretariat for the Asia and Pacific Plant Protection Commission (APPPC) which has 24 countries from Asia-Pacific as members. It works with NPPOs to review the state of plant protection in the region and is actively participating in development of international and regional standards for phytosanitary measures. It also coordinates a regional response to plant protection issues including transboundary pests. The Commission is active in capacity building in the implementation of international and regional phytosanitary standards and in promoting information exchange among its members and other countries in the region. The role of APPPC and contracting parties further increases by envisaging a greater role in managing the transboundary movement of pests in the region. It needs to ensure proper compliance to International and Regional Standards of Phytosanitary Measures with special reference to pest risk analysis, pest surveillance and pest reporting. It is imperative to have regional cooperation and coordination, information sharing about new diseases and pests in the area and a successful management strategy to reduce the spread and adverse impact of trans-boundary pests and diseases. The challenges in the region stem from the fact that the member countries fall in different categories of development which results in different organizational arrangements to execute the various plant protection functions.

Translational Research on Transgenic Crops – K.K. Sharma*

The paper gave an insight into the Platform for Translational Research on Transgenic Crops (PTTC) which was established at ICRISAT with the support of Department of Biotechnology, Government of India to evaluate the potential new genetically engineered crops and advance them in a focused way to meet the specific objective of enhancing agricultural productivity. The presentation also highlighted the bottlenecks and constraints in transgenic crop development by the public sector as well as the private sector. It is meant to take the existing genetic engineering technologies to the development of transgenic crop varieties from product development to commercialization. The major activities would involve genotypic and phenotypic evaluation of trait-specific transgenic events of agricultural importance produced by public and private sector under contained conditions, conduct multi-location and large scale field trials in collaboration with institutions under the Indian Council of Agricultural Research, resolution of IPR issues and development of biosafety dossiers for commercialization of these products through regulatory agencies. Complementing the core activity, PTTC would also leverage its capacities in the form of services to assist public sector research organizations and private companies especially small and medium scale enterprise. PTTC also undertakes various capacity building programs, workshops, conferences/symposia, press releases, publications and a website.

Organizing Biotech Research to Biosafety Compliance – Ruaraidh S. Hamilton*

The presentation elaborated on the use of industrial and agricultural biotechnology in the Philippines which is well established and mostly focused on food and alcoholic beverages. Although, there is no record on the use of GMOs in the food processing industry, the Philippines, like other ASEAN countries, imports much of the soybean and corn used for domestic consumption. Many of the imported commodities are likely to be derived from gene technology. The Philippines was the first ASEAN country to formulate a national policy on biosafety in 1990. The National Biosafety Committee of the Philippines (NBCP) was established to evaluate and recommend measures on the effective utilization of national resources. The Philippine Department of Agriculture has also issued Administrative Order No. 08, governing the importation and release into the environment of plants and plant products derived from the use of modern biotechnology. Under this order, the approval process for importation of regulated articles for direct use as food or feed, or for processing is also included. Research and development in biotechnology has progressed, quite well a substantial part of which is supported by the International Rice Research Institute (IRRI), located in the Philippines of research in developing better plant crop varieties.

Discussion Points:

- Sharing of facilities for early detection and rapid response to Transboundary Animal diseases (TADs) within the region was emphasized. The example of Avian Influenza and the Facility of High Security Animal Disease Laboratory (HSADL) at Bhopal, India were highlighted.
- Dr. Simon Hearn made following points:
  - ❖ Sharing of biosecurity information in the region would greatly help the national quarantine authorities in guarding the countries against pest and disease incursions.
  - ❖ Joint efforts are needed for capacity building by providing trainings/ scholarships etc. which is also one of the good ways of information sharing.
  - ❖ There is a need to work out what constitutes reasonable risk under the SPS Agreement and come to a common regional understanding on this issue.
- Dr. Ruaraidh Hamilton highlighted the new approach of IRRI for working with the national systems to commercialize transgenic rice varieties.
- It was suggested to harmonize the national legal provisions on biosecurity with the international (IPPC) and regional (APPPC) standards. Bilateral agreements also need to be initiated within the region.
- Dr. Suman Sahai suggested APPARI to take a lead in critically reviewing the biosafety systems in the region and the protocols to be used for determining social and economic relevance of GMOs under development.
- Dr. Raj Paroda emphasized the need to understand the biosecurity threats in the region/ sub-region on prioritized pests. He also supported capacity building in the region for knowledge sharing and undertaking anticipatory research in the area of biosecurity.

Group Discussions

Group I – Promoting biotechnology for food security

Facilitator: Dr. Roland Schafleitner, AVRDC- World Vegetable Centre

The group related the capacity and impact of the various biotechnologies in the regions to their economic status and accordingly suggested approaches to promote biotechnology for food security in them. While some capacity of in vitro techniques is available in low developed countries, virtually no capacity for "omics", bio-pesticide/fertilizers or GMO is available in these countries. The impact of biotechnology on food security is expected to be highest in low developed countries.

Techniques	Regions	Capacity Index*	Impact Index**
In vitro techniques	LDC	2	3
	MDC	3	2
	HDC	3	2
"Omics"	LDC	0	3
	MDC	2	3
	HDC	3	3
Biopesticides/fertilizers	LDC	1	3
	MDC	2	3
	HDC	3	3
GMO	LDC	0	3
	MDC	1	3
	HDC	2	1[1)]

LDC: low developed countries, MDC: middle developed countries, HDC: high developed countries
*Capacity Index is based on infrastructure, human talent, policy, entrepreneurship, enabling environment
**Impact index is based on sustainability, impact on human health and food security Scores: 0 (poor) to 3 (high)
1) HDC depends on imports of GM soybean for animal feed. So, although GM plants grown in these countries might not contribute to food security, imported GM plants do.

Means to promote Biotechnology for food security

In vitro techniques, OMICs and bio-fertilizer are the three major means to promote biotechnology for food security in the region. For LDC it may be achieved through appropriate partnerships, training, funding and policies, while for MDC there is a need to stimulate entrepreneurship for production and marketing of products and HDC do not require any further promotion.

Means to promote GMO development in LDC

The major bottlenecks in LDC are inadequate infrastructure, regulations on GMOs and public awareness. To overcome them the strategy would be to:

- Inform the communities about GMO opportunities
- Once biosafety regulations are in place and success stories available, GMO becomes a fore-runner.

- Linking food security to GM development is the best argument to promote GMOs.
- Impact assessment is essential to avoid "unintended impacts"
- Public sector developments into GMO development to improve availability and lessen dependence of multinational companies

Means to promote GMO in MDC

The major bottlenecks in MDC are public trust which may be overcome through:

- Biosafety assessments to be streamlined and done transparently while keeping the rules strict to ensure safety.
- Careful need assessment to be conducted based on availability of technology and funds to decide what kind of GMO crops need to be developed. The ultimate aim for the future would be careful need assessment and application of GMO for the most urgent applications that cannot be satisfactorily resolved by other technologies.
- Improve communication by involving all stakeholders (consumers, farmers, scientists, etc.) with special emphasis on farmers as communicators. Success stories to be communicated to the press and policy makers.
- Public sector developments to decrease dependence of monopolies and to ensure getting the right products.
- Improve public trust through safety assessment conducted by independent and publically funded agencies.
- Impact of research on farmer income especially smallholders and on environment to be demonstrated along with scientific evidence and figures to achieve the desired impact on the stakeholders.

Means to promote GMO in HDC

Overcome the bottlenecks in HDC through political debate and by gaining public trust

Promoting biotechnology at a regional level

At a regional level there is a need to

- Build capacity particularly for omics, biopesticides and biofertilizers, and GMOs. The HDC could provide technical assistance to LDC and MDC in this regard.
- Provide policy support, enhance funding and build partnerships among the various stakeholders.
- Stimulate and encourage entrepreneurships for production, marketing of products based on GM technology.
- Overcome bottlenecks of infrastructure, regulatory uncertainties and low public awareness especially for GM promotion in LDC.
- Demonstrate impact especially publicize success stories of increased farm income and safer environment through technology development and adoption.

Group II – Facilitating biosafety adoption

Facilitator: Dr. Ruaraidh S. Hamilton, IRRI

The group first took stock of the situation regarding biosafety adoption in the region and identified areas where strengthening is required such as in updating the information on biosafety systems in each country, establishing biosafety clearing house mechanisms in accordance to the Cartagena Protocol, review of information databases under the FAO, OECD and APEC, share information on the transgenic events/organisms formally approved by the respective regulatory agencies and share information on import/export, labeling, tolerance threshold, type of material regulated/accepted through the respective authorities on a routine basis. Information gathering and sharing have to be dynamic and not a one-time exercise. Also, regular updation of information on regional cooperation needs to be carried out.

Communication strategy & Awareness

- Promoting awareness and building confidence on the regulatory system.
- Exchange information on best practices, cost-benefit analysis and available information resources.
- Facilitate and organize workshops on communication by involving different stakeholders.
- Facilitate capacity building (especially training of trainers) on different means of communications.

Cooperation

- Identify and facilitate institutions/stakeholders (public-private) for enhancing co-operation for biosafety adoption.
- Assist with market analysis for potential of the transgenic products for its impact on trade.
- Facilitate technology transfer to other countries though public-public or public-private partnerships.
- Develop closer cooperation between NARS & CG Centers.

Training and Stewardship

- Building capacity at the national level on the regulatory framework.
- Building capacity at the institutional level on biosafety expertise.
- Developing capacity for stewardship on transgenic product development and deployment.
- Development of regional, institutional and public-private partnerships for biosafety adoption, technology transfer and for undertaking translational work.

Group III – Building Biosecurity Systems

Facilitator: Dr. J L Karihaloo, Coordinator, APCoAB

The group recognized that agricultural biosecurity is essential for food security, food safety,

biodiversity, market access and human health. The major risks and their impacts were identified as:

- Food security - production and incomes
- Food safety - human health and consumer confidence
- Biodiversity - erosion of genetic resources
- Market accessibility - national economy and trade including non-tariff barriers

Some regional biosecurity threats identified (transboundary pests and diseases) were:

Brown plant hopper on rice, Papaya mealy bug, Ug99 on wheat, Fruit flies including melon fly, Foot and mouth disease, Avian influenza, Nipah viruses (livestock), Swine flu, Newcastle disease, Anthrax, etc.

Managing Biosecurity at Regional Level

- Frame enabling legislations addressing complete food chain.
- Adopt an integrated systems approach.
- Capacity development (infrastructure and human resources) on biosecurity management (diagnostics, detection, disinfestation, risk analysis, survey and surveillance).
- Development of biosecurity related SOPs, procedures and protocols.
- Development of operational linkages across implementing agencies.
- Strengthen communication systems and outreach for generating awareness.
- Enhance supportive research on diagnostics, disinfestation treatments, quarantine, tools for pest identification.
- Information management including development of national pest list, information sharing through a regional information sharing platform.
- Enhance regional cooperation for sharing of expertise and infrastructural facilities.

Issues for Immediate Action at National Level

- Identify major biosecurity threats related to crops, livestock and fisheries.
- Development of national contingency plans in case of incursions.
- National networking with stakeholders, SOPs, procedures and protocols.

Action APAARI

- Organization of expert consultations on related topics.
- Facilitating information exchange including on line discussion forum.
- Success stories and other case studies on biosecurity management.

Plenary Session: Discussion on group recommendations and general recommendations

Chairperson: Dr. Raj Paroda, APAARI

Co-Chair: Dr. Su-San Chang, COA

The facilitators of each group presented the outputs of group discussion. The recommendations as discussed in the previous section were presented by the respective convenors of the Groups and additional recommendations were also made after further discussion:

General Recommendations

- CG centers' need to work as flagships and work in partnership mode with the countries in the region to ultimately give the benefit of the GM technology to the end users. There is a need to prioritize crops for which GM crops are required for specific traits and where marker assisted selection would be required
- Biosecurity issues requiring attention in the region at present are mainly capacity development, knowledge sharing and undertaking anticipatory research and the national leaders and policy makers need to be sensitized on these aspects.
- Anticipatory research to be taken up to deal with potential biosecurity threats in the Region.
- Capacity building and knowledge sharing are cross-cutting issues for biotechnology, biosafety and biosecurity and a project on the same may be submitted to the ADB for promoting biotechnology to meet the Millennium Development Goals in the region.
- Role of APAARI has been to act as interface between FAO and the CG system, hence, there is a need to nurture it
    - ❖ APAARI to find a niche in APEC Commission which would serve as a platform for voicing its concerns and discuss issues. It would take a balanced opinion on biosafety and biosecurity systems in the region and develop a strategy for communication of these.
    - ❖ APAARI should initiate a system of e-consultations on issues related to biosecurity and transboundary pests and diseases
    - ❖ Success and unsuccessful stories of biosecurity/ invasive species management need to be shared within the region so that others may adopt them or learn from the mistakes respectively.
    - ❖ APAARI should organize more of national debates for policy advocacy and public awareness.

Closing Ceremony

Dr. Raj Paroda summed up major recommendations and presented his closing remarks.

Expert Consultation on Agricultural Biotechonology, Biosafety and Biosecturity Taiwan Agricultural Research Institute, Taichung, Chinese Taipei

(27-28 October 2011)

Program

	27-Oct-11	
09:00-09:30	**Registration**	
09:30-10:30	**Inaugural Session**	
	Welcome Address	Dr. Raj Paroda, Executive Secretary, APPARI
	Welcome Address	Dr. Junne-Jih Chen, Director General, TARI, COA
	Opening Remarks and Release of Publication	Dr. Su-San Chang on behalf of Dr. Wu-hsiung Chen, Hon'ble Minister, COA
	Vote of Thanks	Dr. J. L. Karihaloo, Coordinatior, APCoAB-APAARI
10:30-11:00	**Group Photograph & Tea Break**	
	Session I:	
	Status of Biotechnology, Biosafety and Biosecurity R&D in Asia-Pacific - Country Status	
	Chair: Dr. Dyno Keatinge	
	Co-Chair: Dr. Su-San Chang	
11:00-11:20	1. India	Dr. R.K. Khetarpal, CABI
	2. Malaysia	Dr. Abd Shukor Abd Rahman & Dr. Umi Kalsom, MARDI
	3. Nepal	Dr. Dinesh Pariyar, NARC
	4. Philippines	Dr. Patricio S. Faylon, PCAARRD, Philippines
12:00-13:00	**Lunch Break**	
13:00-13:20	5. Sri Lanka	Dr. M.T.K. Gunasekare, SLCARP
	6. Chinese Taipei	Dr. Kuo-Yun Fang, COA
	7. Vietnam	Prof. Vu Manh Hai, VAAS
15:00-15:30	**Tea Break**	
	Session II:	
	Status of Biotechnology, Biosafety and Biosecurity R & D in Asia-Pacific - Regional Status	
	Chair: Dr. Abd Shukor Abd ahman	
	Co-Chair: Mr. Mason Smith	
15:30-15:50	1. Pacific	Dr. Raghunath Ghodake, NARI
	2. Africa	Prof. Walter Alhassan, FARA
	3. Asia	Dr. J.L. Karihaloo, APCoAB-APAARI
18:30	**Dinner hosted by COA**	

28-Oct-11

Session III:
Advances in Biotechnology for food security

	Chair: Dr. Thomas Lumpkin	
	Co-Chair: Dr. Raghunath Ghodake	
09:00-09:20	1. The contribution of biotechnology to stress tolerant vegetable crops	Dr. Roland Schafleitner, AVRDC
09:20-09:40	2. Genetic engineering technology to produce crops tolerant to environmental stresses	Dr. Kazuo Nakashima, JIRCAS
09:40-10:00	3. Biotechnology: An Imperative in sustainable for Food Production	Dr. Francis C. Ogbonnaya, ICARDA
10:00-10:15	Discussion	
10:15-10:45	**Tea Break**	

Session IV:
Advances in Biosafety and Biosecurity

	Chair: Dr. Nicomedes P. Eleazer	
	Co-Chair: Dr. Dinesh Pariyar	
10:45-11:05	1. Biosecurity in Asia-Pacific-Status and Future	Dr. R.K. Khetarpal, CABI
11:05-11:25	2. Translational research on transgenic crops	Dr. K.K. Sharma, ICRISAT
11:25-11:45	3. Organizing biotech research to biosafety compliance	Dr. Ruaraidh S. Hamilton, IRRI
12:00-13:00	**Lunch**	
13:00-16:00	**Group Discussion**	
	Topics:	**Facilitator:**
	1. Promoting biotechnology for food security	: Dr. Roland Schafleitner, AVR
	2. Facilitating biosafety adoption	: Dr. Ruaraidh S. Hamilton, IRRI
	3. Building biosecurity system	: Dr. J.L. Karihaloo, APCoAB
16:00-16:20	**Tea Break**	
16:20-17:00	**Plenary Session**	
	Chair: Dr. Raj Paroda, APAARI	
	Co-Chair: Dr. Su-San Chang, COA	

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Asia-Pacific Association of Agricultural Research Institutions

Asia-Pacific Association of Agricultural Research Institutions (APAARI) was established in 1990 at the initiative of Food and Agriculture Organization of the United Nations and most of the National Agricultural Research Systems (NARS) of the Asia-Pacific region. Its mission is to promote the development of National Agricultural Research Systems in Asia-Pacific region through facilitation of inter-regional, inter-institutional and international partnerships.

APAARI's vision is that Agricultural Research for Development (ARD) in the Asia-Pacific region is effectively promoted and facilitated through novel partnerships among NARS and other related organizations so that it contributes to sustainable improvements in the productivity of agricultural systems and to the quality of the natural resource base that underpins agriculture, thereby enhancing food and nutrition security, economic and social well being of communities and the integrity of the environment and services it provides.

The overall objectives of APAARI are to foster the development of agricultural research in the Asia-Pacific region so as to:

- Promote the exchange of scientific and technical information
- Encourage collaborative research
- Promote human resource development and capacity building
- Build up organizational and management capabilities of member institutions
- Strengthen cross-linkages and networking among diverse stakeholders

To know more about APAARI, please visit: www.apaari.org

Asia-Pacific Consortium on Agricultural Biotechnology

Asia-Pacific Consortium on Agricultural Biotechnology (APCoAB) was established in 2003 under the umbrella of Asia-Pacific Association of Agricultural Research Institutions (APAARI). APCoAB has the mission to "harness the benefits of agricultural biotechnology for human and animal welfare through the application of latest scientific technologies while safeguarding the environment for the advancement of society in the Asia-Pacific Region". APCoAB's main thrusts are (i) to serve as a neutral forum for the key partners engaged in research, development, commercialization and education/learning of agricultural biotechnology as well as environmental safety in the Asia-Pacific region; (ii) to facilitate and promote the process of greater public awareness and understanding relating to important issues of IPR, sui generis systems, biosafety, risk assessment, harmonization of regulatory procedures, and benefit sharing in order to address various concerns relating to adoption of agricultural biotechnology; and (iii) to facilitate human resource development for meaningful application of agricultural biotechnology to enhance sustainable agricultural productivity, as well as product quality, for the welfare of both farmers and consumers.

To know more about APCoAB, please visit: www.apcoab.org

About Council of Agriculture and Taiwan Agricultural Research Institute

The **Council of Agriculture (COA)** is the competent authority on the agricultural, forestry, fishery, animal husbandary and food affairs in Chinese Taipei. Its responsibilities include guiding and supervising provincial and municipal offices in these areas. Under the council there are Department of Planning, Department of Animal Industry, Department of Farmers' Services, Department of International Affairs, Department of Science and Technology, Department of Irrigation and Engineering, Secretariat, Personnel Office, Accounting Office, Civil Service Ethics Office, Legal Affairs Committee, Petitions and Appeals Committee and Information Management Center respectively in charge of related affairs.

The **Taiwan Agricultural Research Institute (TARI)** was established in 1895 by the then Taiwan Gubernational Government under Japanese rule. Subsequently, the institute was renamed as Agricultural Research Institute (ARI) and has been operated under the supervision of COA since 1999.

TARI headquarters occupies 145 ha including 17 ha of building and various constructions and 128 ha of experimental farms served by a complete irrigation and drainage system. The institute conducts both basic and applied research for, agronomic and horticultural crops in the fields of breeding and genetics, physiology, tissue culture, biotechnology, soils fertility and plant nutrition, diseases and pest managements, farm machineries, meteorology, agricultural economics, and extension. The varieties and technologies developed by the institute in the last fifty years have contributed greatly to agricultural production and a rapid progress in rural economic development.

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