FNCA
Forum for Nuclear Cooperation in Asia

Lecture 1: 13:15 – 13:40

International Nuclear Cooperation and Contribution for Asian Countries

International Nuclear and Fusion Energy Affairs Division, Research and Development Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan

For effective cooperation and contribution for peaceful use of nuclear technology in Asian countries, we are conducting following three programs;
I) The Nuclear Researcher Exchange Program welcomes nuclear researchers from Asian countries to Japan. In this program, Japanese research institutes/universities accept Asian researchers studying and/or working in the field for the peaceful use of nuclear technology for up to 6 months. II) Instructor Training Program invites technical instructors of Asian countries to Japan to participate in training courses for up to 8 weeks. The participants give lectures at the Follow-up Training Course in their countries. They become excellent instructors by the accumulation of teaching experiences year by year through the course. III) Forum for Nuclear Cooperation in Asia (FNCA) is a framework of Asian international cooperation for peaceful use of nuclear technology. Currently, 8 coordinated projects on various nuclear/radiation fields such as industry, environment, healthcare, safety and security, are in progress by experts of member countries.
These three programs have synergy for the effective cooperation and contribution.

Lecture 2: 13:40 – 14:05

Agricultural Efficacy of Radiation –Modified Carrageenan as Plant Growth Promoter

Dr Lucille V. Abad, Philippine Nuclear Research Institute, Department of Science and Technology, the Philippines

Degradation by radiation processing of polysaccharides is known to produce low molecular weight fragments. These radiation degraded polysaccharides can induce various kinds of bioactivities such as growth promotion of plants.
Kappa carrageenans are hydrophilic polymers that comprise the main structural polysaccharides of numerous species of seaweed Eucheuma. They are composed of D-galactose units linked alternately α(1,3)-D-galactose-4-sulfated and β(1-4)-3,6-anhydro-D-galactose. Gamma irradiation of κ-carrageenan produces fragments with an Mw < 10,000 which increases yield in Pechay plants when applied either by foliar spraying or in hydroponics condition. (Abad, et al., 2015).
Recent studies in the Philippines using field trials indicated improved agronomic traits with an increase in yield of 19-87% and 16-51% against the usual farmer's practice for mung bean and peanuts, respectively.
Multi-location trials of around 5,000 ha rice field in different regions of the Philippines indicated a dramatic increase in yield of 20- 30%. Increased resistance to tungro virus was also noted. Likewise, there was extensive root growth and sturdy stems that prevent lodging of rice plant.
Semi-commercial production of radiation modified carrageenan by e-beam irradiation has throughput of around 1,800 L / hr.

Lecture 3: 14:05 – 14:30

Plant Growth Promotion of Chitin and Chitosan

Prof Hideo Kusaoke, Department of Environmental and Food Sciences, Fukui University of Technology, Japan
Prof Hisashi Kimoto, Department of Bioscience, Fukui Prefectural University

Plants produce chitinase and degrade chitin constituting the cell wall of pathogenic microorganisms, and then degradation products of chitin with chitinase, chitin-oligosaccharides are introduced into plant cells and promote plant growth by inducing disease resistance. Glucans constituting cell walls of molds and yeasts as well as chitin also have the action of plant growth promotion (PGP). Plants incorporate chitin- and glucan-oligosaccharides called an elicitor into cells, and produce phytoalexin as an antimicrobial substance induced by the elicitor. The phytoalexin secretes extracellularly and exhibits the resistance to pathogenic microorganisms.
In this study, we first describe the mechanism of elicitor activity showing disease resistance induced by chitin and glucan, and the method of measuring the elicitor activity. Next, we describe the application for PGP of chitin, deacetylated chitin (chitosan), and microorganisms producing the chitinase.

Lecture 4: 14:30 – 14:55

Effective Production of Plant Growth Promoter with Radiation Processing and Versatile Applications

Dr Nguyen Ngoc Duy, VINAGAMMA Center, VINATOM, Vietnam

Application of radiation processing to degrade natural polysaccharides such as chitosan, alginate, ß-glucan, carrageenan, using them as plant growth promoter in agriculture has been considered as an efficient and convenient method due to several reasons, for instance: carrying out at room temperature, ease of process control, large scale production and environmentally friendly processing method. Large scale production of oligosaccharides by radiation processing is briefly outline. The application of oligosaccharides typically oligo-alginate, oligo-chitosan, oligo-carrageenan, oligo-ß-glucan, as plant growth promoter for rice, chili, soybean, etc. is presented. Beside the productivity promotion effect, the content of bioactive substances such as curcumin in turmeric, isoflavone in soybean seed, artemisinin in Artemisia annua L, is remarkably increased by the treatment of oligosaccharides as well. Furthermore, oligosaccharides also were applied as immunostimulants and growth performance for aquaculture and livestock farming. Applications of oligosaccharides as plant growth performance, immunostimulants and growth performance for sustainable agriculture and aquaculture have been showed effectively economical benefit and therefore should be further developed.

Lecture 5: 15:10 – 15:35

Application of Super Water Absorbent developed by Radiation Processing to Sandy Soil

Dr Mitsuhiro Inoue, Professor Emeritus, Tottori University, Japan

It is estimated that the world population will increase significantly by 2050, thereby putting greater pressure on global food security. This will have a direct effect on agricultural water usage, especially in dryland sandy soils, where water shortage is often the most limiting factor determining the crop production. Cultivation technique

that is based on appropriate soil and water management is a key point in the agricultural production of the sandy soil, particularly in the drylands. The introduction of small amount of frequent irrigation, the injection of soil conditioner in order to raise water holding capacity, the application of mulch to topsoil for reducing soil surface evaporation are the available and effective water-saving techniques.
In this study, two soil conditioners, 1) a super absorbent polymer (SAP) used for paper diaper, and 2) a super water absorbent (SWA) developed by radiation processing technique were applied to Tottori dune sand. Water absorption and water holding capacities of sand-SAP and sand-SWA mixtures during wetting and drying process with different salt concentration of NaCl solution were examined using a tea pack method. Results show that the water saving effect of sand-soil conditioner mixtures were acceptable. However, it showed a sustained-release problem in which the water holding capacity fall with the time, and the influence of salinity was also pointed out. The application of soil conditioners to house cultivation of tomato led to yield increase. The durability of the soil conditioners effect on sandy farmland depends on the application method of the conditioners, such as mixture depth in the outer layer, and the undergrounding of the root zone lower layer. The economics of its application to future agriculture was also considered.

Lecture 6: 15:35 – 16:00

Characterization of Bacillus Biofertilizer "Kikuichi" for Paddy Rice

Prof Tadashi Yokoyama, Institute of Agriculture, Tokyo University of Agriculture and Technology, Japan

We developed *Bacillus* biofertilizer "Kikuichi" for paddy rice. This biofertilizer is a granule type, and spores of *Bacillus pumilus* TUAT1 are absorbed by the granule having base material of zeolite and diatomite. Size of granule is around 3 mm and 10^7 spores keep in one gram of granules. Quality of this biofertilizer can keep around 1 year at room temperature. When *Bacillus* biofertilizer "Kikuichi" applies to rice seeds in nursery boxes, the seedlings show over 30% of increase of root growth such as root number and root weight of rice seedling against the control plants without "Kikuichi". When the rice plants with "Kikuichi" transplant to paddy field, root growth are keeping in paddy field and promote nitrogen fertilizer uptake. These inoculation effects induce an increase of tillers of treated rice plants, therefore, application of "Kikuichi" increase yields of brown rice at 10 to 20%. Rice plants applied "Kikuichi" promote an efficiency of fertilizer utilization in order to develop root systems, therefore this property directly connect to reduce amounts of fertilizer application.

Lecture 7: 16:00 – 16:25

Trends of Biofertilizer in the Philippines

Ms Julieta A. Anarna, National Institute of Molecular Biology and Biotechnology, University of the Philippines Los Baños, the Philippines

Biofertilizers or microbial inoculants are the products that contain efficient strains of beneficial microorganisms. These potential biological fertilizers would play key role in crop production which can be used as fertilizer to increase , as soil conditioner, reduce environmental damage and cost effective inputs for the farmers by decreasing production cost and provide other physiological benefits to crops.
Rhizobium, Azospirillium, Mycorrhiza, and P-solubilizing bacteria are examples of microbial inoculants used as biofertilizers and as alternative inputs to meet the

nutrient requirement of crops.
In the Philippines the sources of biofertilizers come from local producers (government and private sector) and from international market. The National Institute of Molecular Biology and Biotechnology (BIOTECH) University of the Philippines Los Baños conducted intensive research and development on biofertilizers. The institute has produced wide arrays of microbial inoculant products from Azospirillium, Mycorrhiza, Rhizobium, PGPR and Trichoderma species.
A number of studies and researches conducted regarding biofertilizers have depicted the marketability and acceptability of biofertilizer among thousands of farmers in the country. The active involvement of research institutions, private individuals and enterprises have favored the growth of the biofertilizer industry. Almost all of the biofertilizer products developed are currently commercially available. Technology transfer was done with the government and private sector.

Lecture 8: 16:25 – 16:50

Bio-(Organic) Fertilizer Development in Indonesia

Prof Dr Iswandi Anas, Faculty of Agriculture, Bogor Agricultural University (IPB), Indonesia

Intensive agriculture practice, using only artificial NPK fertilizers and chemical pesticides had been reported to damage agriculture soils and caused serious environmental pollution in Indonesia. To solve these problems, Ministry of Agriculture had launched various programs such as promoting the use of organic and biofertilizer, issued regulation to control the quality of commercial organic fertilizers, biofertilizers, bio-organic fertilizers as well as soil amendments, supporting the group of farmers to produce organic fertilizers by providing necessary equipments etc.
In the period of 2010-2015 and follow by period 2015-2019, Ministry of Agriculture of Republic Indonesia has strongly supported the programmes to stimulate the use of organic fertilizers, biofertilizers, bio-organic fertilizers and at the same time to reduce the rate of application of artificial NPK fertilizers. Selection of the best biofertilizers and bio-organic fertilizers for several important crops such as rice, maize, soybean, onion, chilli, sugarcane and potato had been carried out.
On the other hands, researchers in several universities and research institutes collaborated with National Atomic Energy (BATAN) had successfully showed that the sterilization of several inoculants carriers using Co-60 Gamma Rays had improved the quality of biofertilizers and bio-organic fertilizers. The use of the biofertilizers and bio-organic fertilizers by farmers had significant impact reduction of the rate of artificial NPK fertilizers. In the last few years, the use of gamma irradiation for improving the quality of inoculant microbes also had been reported.