Forum for Nuclear Cooperation in Asia (FNCA)
Electron Accelerator Application Project

Summary of the Workshop (Parallel Sessions)

Vietnam Trade Union Hotel & Vietnam Atomic Energy Agency (VINATOM)
Vietnam
9th - 11th November 2016

1) Outline of Workshop

i) Date	9th - 11th November 2016
ii) Venue	Vietnam Trade Union Hotel, Hanoi Vietnam Atomic Energy Agency (VINATOM), Hanoi
iii) Host Organisation	Vietnam Atomic Energy Agency (VINATOM) and Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT)
iv) Participants	Thirteen (13) participants from eight (8) FNCA member countries: Bangladesh, Indonesia, Japan, Malaysia, Mongolia the Philippines, Thailand and Vietnam

2) Workshop Program (Parallel Sessions)

The parallel sessions were attended by experts on applications of electron accelerator and radiation processing of natural polymers from eight (8) FNCA participating countries namely Bangladesh, Indonesia, Japan, Malaysia, Mongolia, the Philippines, Thailand and Vietnam.

Parallel Session 1: <PGP> Wrap-up I, Obstacles in Research and Commercialization

Dr Amartaivan Tsenddavaa summarized Session 1 of the Joint Session, focusing on obstacles in research and commercialization of Plant Growth Promoters (PGP), which the countries that are aiming for commercialization of PGP are now facing. The meeting discussed on the theme after the lead speech.

<Abstract of Speech>

Bangladesh, Mongolia and the Philippines were shared results of their research studies on PGP effect and challenges to commercialization in this session.

Bangladesh is in Field test stage, the Philippines is in semi commercialization stage but Mongolia is in Research stage.

They have own obstacles toward commercialization which are specific to their own conditions. It should be clarified and supported next things for commercialization;

- Tangible results of PGP effect on plants of farmers interest which can lead the farmers to increase revenue and outreach of nuclear technology application

- Support and budget for research for lab experiments, field test as well as collaboration with farmers

<Discussion Summary>

Many of country member have express their problem with the Registration and Classification of the developed PGP. They need to provide lots of data field to support the registration. Japan requires a toxicity study because the PGP is classified as pesticide. Philippine explained that there are not enough data on drier and wet season due to the typhoon. For Indonesia, they have problem in classification of their PGP and the Government cooperation is not really satisfactory. Indonesia need to wait for the local government to do the study in order to classified the PGP. Lack of funds from the government is the major problem faced by the country member. They need funds to do fields test in larger scale. Some of the Government in the country member also has different priority in giving the fund to do research. 90% of field test of PGP in Indonesia are in remote area and difficult to do follow-up (resources). In addition, lack of expertise in agricultural field also hinder some of the commercialization process. Bangladesh is still in field test for different type of crops. As for Mongolia, the main obstacle is the raw materials and the unavailability of irradiation facility. The public acceptance is also very low. Thus, they do some seminar on PGP to increase the awareness of nuclear technology application. Members learn lots from Philippine experience in commercializing the PGP. They have full support from the political party, farmers, chemist and agricultural department.

Parallel Session 2 : <PGP> Wrap-up II, New Research

Dr Darmawan Darwis summarized Session 1 of the Joint Session, focusing on new research of oligochitosan, which the countries that have already achieved commercialization of PGP are now engaged in. He also proposed the members to suggest new research theme.

Parallel Session 3: <SWA> Country Report I, Current Status and Obstacles in Research and Commercialization

Five (5) country reports were presented on current status and obstacles in research and commercialization of Super Water Absorbents (SWA).

Parallel Session 4: <SWA> Wrap-up I, Obstacles in Research and Commercialization

Dr Nguyen Cuoc Hien summarized Parallel Session 3. The participants discussed on the theme after the lead speech.

<Abstract of Speech>

Bangladesh:

Bangladesh used CMC-co-AAc SWA Hydrogel for Semi field experiment on egg-plant. SWA on egg plant in sandy loam soil can reduce watering frequency from once a day to twice a week .The effect of SWA on egg plant increased the morphological values i.e., plant height, number of flowers, number of fruits, weight of fruits with compared to control .The yield of egg-plant per plot with SWA, combination of SWA with o-chitosan, o-chitosan and control are 18.57, 19.0, 19.68 and 9.18 kg plot-1 respectively.The future plan of Bangladesh is to continue the application of SWA on egg plant and maize in field scale and will try to expand it in large scale with collaboration of agriculture scientist and also will try to collaborate with Bio-fertilizer group according to Dr. Tamada's suggestion.

Indonesia:

Indonesia used Cassava –co-acrylate SWA hydrogel for the water use efficiency and growth of Shallot (Allium Ascalinicum) in sandy loam soil. Cassava –co-acrylate SWA hydrogel improve water irrigation efficiency on shallot plant in sandy soil from twice a day to twice a week during the dry season/off season, increase height of shallot plant and combination treatment of SWA and chitosan give the maximum plant height of shallot and also increased the yield %. Cassava –co-acrylate SWA (0.5gm per plant) with 50 ppm o-chitosan gives the best performance and gives highest yield (140%). In the case of chilli plant, 0.5gm SWA with 50 ppm o-chitosan (per plant) at sandy soil is effective in increasing yield (yield increase upto 184%), number of shoot , reduce disease and also harvesting time increase 11 times to 15 times. The effect of SWA on the growth of soil micro-organisms, water efficiency and biomass on caisin is not ready yet. The work is on going.

Malaysia:

Malaysia used Sago–co-acrylate SWA on kailan, spinach and green mustard plant. 0.5% sago SWA increased the weight on Kailan, Spinach and green mustard plant 9.8, 36 and 50 % respectively. In the case of Green Mustard, 1% and 1.5% SWA increase the plant weight 43% and 100%, respectively compare to control. Malaysia also used SWA on shallots (Allium cepa cv. Aggregatum) in sandy soil for pot test study. The study is still in an early stage, but based on the preliminary results 0.1% SWA give highest plant height, and 0.3% SWA give highest number of bulbs and leaves. The results is not conclusive yet as it will requires another few weeks to complete.

Mongolia:

Mongolia prepared SWA (Na-AAc with rice husk/straw) using 10 to 40 kGy irradiation but no gel formed. But in the case of CMC –straw/husk SWA, it formed gel. The properties of

CMC –straw/husk SWA was measured using FTIR, IR etc. The optimum condition and water retention properties of CMC –straw/husk SWA will measure.

Philippine:

0.25%Kappa-carrageenan/PAA SWA shows water retention capacity 10% on 14days whereas control shows 2-3% on same days. In the case of control (without SWA), 0.25%, 0.5%, 0.75% and 1.0% Cassava Starch/PAA SWA, shows water retention capacity on 16 days 2, 3, 15, 35 and 40% respectively. Soil moisture retention of 0.5% cassava-starch/PAA SWA on 16 days give 18%, whereas Terrasorb (0.5%) shows 40% soil moisture retention on same days. The degree of swelling of K-Carageenan/PAA and Cassava starch/PAA SWA in water is » 700 g water/g and » 170 g water/g, respectively. Gel fraction of prepared SWA like K-Carageenan/PAA and Cassava starch/PAA are 65-75%, 70-80% respectively.

<Discussion Summary>

Lead speech of this session was given by Dr Hien, Vietnam to summarize the presentations of Bangladesh, Indonesia, Malaysia Mongolia, and Philippines which have challenged the commercialization of SWA. Discussion noted as follows:

- Share of information in the presentations for preparation of SWA and its evaluation in terms of water content, SWA concentration in soil, etc. solved the obstacles originated from insufficient know-hows in the on-going research.
- Effect of SWA on the plant growth in arid condition should be reconsidered in a drop irrigation system which can reduce the required amount of SWA in soil. Save of the SWA amount in soil leads higher cost effectiveness and promotes the technology transfer of SWA for its commercialization.

Parallel Session 5: <SWA> Country Report II: New Research and Needs Analysis

Three (3) country reports were presented on new research and needs analysis of SWA.

Parallel Session 6: <SWA> Wrap-up II, New Research and Needs Analysis

Dr Phiriyatorn Suwanmala summarized Parallel Session 5. The meeting discussed on the theme after the lead speech.

<Discussion Summary>

Research and development of SWA prepared by radiation crosslinking and or grafting for soil conditioner have been done in FNCA MSs. Carboxymethyl cellulose hydrogel was produced by electron beam irradiation for wall paper and lamp shade and has been commercialized by NHV (Nissin High Voltage) cooperation in Japan. New research on the potential usage of SWA from hydroxypropyl cellulose with 2-hydroxyethyl methacrylate, polyethylene glycol dimethacrylate, and hydroxymethyl phosphonium chloride for radiation dosimeter in the treatment of cancer has been conducted in Japan. The gel can be used as 2D dosimeter for

visualize dose distribution on body surface or used as 3D dosimeter for dose distribution in cancer therapy. In Thailand, the effect of particle size of SWA on swelling ratio in distilled water, tap water, and ground water were investigated. The results showed that SWA with smaller particle size has higher swelling ratio than larger particle size up to the equilibrium state of water absorption. The effect of SWA on water absorption of soil was studied. The results showed that without SWA the water absorption of soil decreased with increasing the addition of water. Soil without SWA has higher drained water than soil mixed with SWA. The effect of SWA on drought resistance on pomelo was also studied. The results showed that SWA can give drought resistance on pomelo. In Vietnam, the study and development of SWA have been carried out since 2005. Acrylic acid grafted starch treated by gamma radiation with a trade-name called "GAM-Sorb" has been producing at a pilot-scale with an annual production of 3 tones. GAM-Sorb is a trade name of soil humidity conditioning material, which is often called SWA. The usage of material is considered as one of the most useful solutions for farming in the drought-stricken, arid or water-lacking areas due to climate change. Other application of SWA Carrier for foliar feeding has also been studied. Research on nanogel of poly (vinylpyrrolidone) in combination with some micro-elements for foliar feeding with the name "Nanopolidone" was carried out.

Parallel Session 7: Coordination between FNCA and RCA/IAEA Projects on Radiation Processing

Dr Marina Bint Talib reported on coordination between FNCA and IAEA/RCA projects on radiation processing, followed by the discussion by the participants.

<Abstract of Speech>

One of the RCA/IAEA is RAS 1014: Project Supporting Radiation Processing for the Development of Advanced Grafted Materials for Industrial Applications and Environmental Preservation (RCA). The objective of this project is to produce advanced grafted products for industrial applications and for mitigating environmental pollution by using radiation processing. Amongst the outcomes of the project is superwater absorbent products which is one of the focus in FNCA's project. RCA/IAEA members are welcome to share or exchange information/documents for the success of the projects involved. The cooperation between both projects should continue and supported.

<Discussion Summary>

Dr Marina Binti Talib presents the project activity of RAS1014. Researchers in RCA GP such as India, Sri Lanka, and Pakistan of non FNCA member countries request the information of achievements in PGP and SWA development. However, there is no participant from RCA GP of non FNCA member countries in this workshop though FNCA project

welcomes accepts the participation of non FNCA members from in RCA project. . FNCA project members will update the guideline about development of hydrogel and oligosaccharides by radiation processing to provide information through WEB page. Member countries agreed to share the information by uploading the guideline "FNCA Guideline on Development of Hydrogel and Oligosaccharides by Radiation Processing" onto FNCA WEB page after updating in the radiation processing of hydrogel and oligosaccharides.

Parallel Session 8: Future Plan (2016-2017)

Dr Masao Tamada made a speech on future plan of the project, followed by the discussion by the participants.

<Abstract of Speech>

Electron accelerator application project is in the 5th phase at present. This project was launched in 2001FY to explore a new radiation processing of polymers. New processing technologies were developed for wound dressing, face mask, functionalization of natural polymer, and flue gas treatment. The radiation processing of natural polymers in the 2nd phase for 2006FY R&D developed silk soap and pant growth promoter. In the 3rd phase from 2009FY R&D on plant growth promoter (PGP) and super water absorbent (SWA) from natural polymers became major subjects. The project has concentrated in technical transfer of developed PGP and SWA to end-users since the 4rd phase (2012FY - 2014FY).

In the phase 5, from 2015FY to 2017FY, the project intends to support all participating countries to commercialize PGP by mutual consulting to solve the problems and obstacles in its technology transfer. In the case of SWA, the possibility of commercialization will be evaluated in terms of performance and cost effectiveness. After evaluation of achievements at the end of the 5th phase, continuation of the project will be determined in coordinator meeting. New promising applications in the 6th phase from 2018FY will be expected in all participant countries.

<Discussion Summary>

After Dr Tamada's presentation, participants discussed on two issues: plan for 2017 and prolongation of the project from 2018. Each country filled the table (Annex 2-6 :Table. Direction in Electron accelerator application) its future activity on PGP and SWA next year. Member countries mainly agree to prolong the project from to have clear results on SWA and PGP commercialization. Main obstacles and detailed activities are discussed in detail during another sessions.

Parallel Session 9: Summary

Mr Fernando Aurigue, Philippine Nuclear Research Institute, summarized the workshop, and the workshop minutes was adopted with some modifications by the participants.

Parallel Session 10: Preparation for Closing Session of Joint Workshop

Dr Nguyen Quoc Hien summarized overall parallel sessions for the preparation of closing session of Joint Workshop. See Annex 2-7 for more details.

Technical Visit

The participants visited 108 Military Central Hospital in the morning of 9 November. Dr Vu Thanh Quang, Diector of the 30 MeV Cyclotron Centre of the hospital introduced their facilities to the participants.