Summary of Country Reports on Super Water Absorbent (SWA)

Part 1. Country Report on Hydrogel SWA

(1) Bangladesh (Dr Salma Sultana, Bangladesh Atomic Energy Commission (BAEC))

A semi-field experiment was done at Atomic Energy Research Establishment, Savar, Bangladesh during the period from November 2015 to March 2016 to investigate the effect of SWA, oligo-chitosan, combination of SWA & o-chitosan application on morphological characters, growth and yield in egg-plant. The effect of SWA and combination of SWA & o-chitosan on egg plant increased the morphological values i.e., plant height, number of flowers, number of fruits, weight of fruits with compared to control. It has also found that SWA on egg plant in sandy loam soil can reduce watering frequency from once a day to twice a week. Therefore, SWA with foliar application of oligo-chitosan at 60 ppm may be recommended for egg-plant after few more field trials.

(2) Indonesia (Dr Darmawan Darwis, National Nuclear Energy Agency (BATAN))

Super water absorbent hydrogel (SWA) was made by radiation crosslinking of cassava starch and acrylic acid with dose of 15 kGy. This hydrogel have water absorption capacity up to 300 time of its dry weight. The effect of SWA concentration and watering frequency and the influence of addition of oligochitosan on shallot plant in sandy soil during off season has been conducted. Four concentrations of SWA 0 (control), 0.25, 0.5 and 1 gram per plant and watering frequency 2 times a day, 2 times a week and 1 time a week were studied in this experiment. The results showed that addition of SWA to the soil improve water irrigation efficiency from twice a day to twice a week, increase the plant height, diameter of bulb, number of bulb per hill, and yield. The optimum concentration of SWA for shallot plant is 0.5 gram per plant. Control plants with watering once a week were died in 50 DAP, while plant treated with SWA with concentration 0,5 g/plant, 1 g/plant, and combination of SWA-chitosan can survive. Aplication of SWA 0.5 gram/plant in combination with o-chitosan 50 ppm foliar spray every 2 week and water irigating twice a week give highest yield among treatments used. The increase in yield is 140% compared to the control. Combination treatment of SWA and oligochitosan and watering as much as twice a week throughout the shallot crop cultivation gives the best performance. Application of SWA and o-chitosan for chili plant in sandy soil has been conducted. The results showed that combination treatmen of SWA and oligochitosan for chili plant at sandy soil is effective in increasing of yield, number of shoot and reduce disease. The yield increase up to 184 % compared to control. The harvesting frequency increase from 11 times to 15 times.

(3) Malaysia (Dr Marina Talib, Malaysian Nuclear Agency (Nuclear Malaysia))

The current status of SWA in Malaysia is still in optimizing the parameter in pot test stage for shalots in sandy soil. The SWA was prepared from sago waste and 3 different concentration was studied (0.1,0.3 and 0.5%). Due to lack of fund, the study could only begin at end of October and only 1 reading could be

collected before the meeting. There is still further study need to be done in order to have a conclusive study.

(5) Mongolia (Dr Amartaivan TSENDDAVAA, National University of Mongolia

We have tried to methods for SWA production. First method is that Dr. Hien (Vietnam) was proposed at FNCA meeting before. Here sodium acrylate (NAAc) was produces with 1V of 50% of NaOH dropping 1V of 40% of acrylic acid. 3, 5, 9% of wheat husk and wheat straw sample were mixed to NAAc mixture respectively. Samples were irradiated 10kGy and 20 kGy dose. Swelling ratio of irradiated samples was lower than expected. Gel fraction of irradiated samples was about 90% and more.

Second method was mixing the samples with 20% of CMC. Samples were irradiated 10 and 20kGy. In the case of 3% of wheat straw added to 20% of CMC irradiating 10kGy, swelling ratio was the highest, about 250 g/g. Optimum condition for production of SWA with wheat husk and straw will continue next year.

(6) The Philippines (Mr Fernando AURIGUE, Philippine Nuclear Research Institute (PNRI))

Research and Development activities for production of super water absorbent (SWA) with application to agriculture in the Philippines is hampered by lack of funding. Nevertheless, something was done for testing under controlled conditions.

For 2016, cassava starch (S) was used as raw material instead of semi-refined κ-carrageenan (KC) for economic and technical reasons together with polyacrylic acid (PAA) following the production method of Indonesia. Different concentrations of S/PAA SWA were tested to determine soil moisture retention in equal parts of garden soil and sand mixture for 16 days. The efficacy of 0.5% S/PAA SWA was compared to that of a commercial product available in the market and it was found that a lot of improvement still has to be made to make S/PAA SWA at par with TerrasorbTM.

The degree of swelling in water and gel fraction of S/PAA SWA were compared to those of KC/PAA SWA that were determined earlier. However, results of their actual use in crop production are yet to be verified by conducting pot experiments on selected crops. Likewise, the biodegradability of SWA will be studied at the National Institutes for Quantum and Radiological Science and Technology (QST) in Takasaki, Japan using Microbial Oxidative Degradation Analyzer (MODA).

Semi-field tests and field-scale experiments can only be conducted based on the results of the preliminary experiments and only when the new project proposal will be approved and funded.

Part 2. Country Report on SWA and Future Possibilities and Needs Analysis

(1) Japan (Dr Mitsumasa TAGUCHI, National Institutes for Quantum and Radiological Science and Technology(QST))

Gel indicator/dosimeter was developed by the radiation cross-linking technique for an evaluation of radiation dose under the cancer treatment. Gel indicator/dosimeter consists of plant-derived hydroxypropyl cellulose hydrogel and less toxic reagents such as 2-hydroxyethyl methacrylate, polyethylene glycol

dimethacrylate, and tetrakis (hydroxymethyl) phosphonium chloride. Gel indicator/dosimeter became turbid after the irradiation of □-rays and X-rays, C ions at the dose of 1 to 10 Gy. The turbidity was confirmed by visual observation and analyzed quantitatively by using a UV-Vis spectrophotometer and also PC scanner. Two- and three-dimensional dose distributions can be evaluated by using the developed gel indicator/dosimeter.

(2) Thailand (Dr Phiriyatorn SUWANMALA, Thailand Institute of Nuclear Technology(TINT))

The superabsorbent (SWA) was synthesized by radiation-induced graft polymerization of acrylic acid onto cassava starch. A pilot plant for the production of SWA with the capacity of 300 kg /day was set up at Thailand Institute of Nuclear Technology (TINT), Nakorn-Nayok Province. Researchers at TINT performed a pot test of SWA with pomelo in order to study the effect of SWA on drought resistance of pomelo .The results showed that the application of SWA can help drought resistance of pomelo.

TINT is coopering with the Office of the Rubber of Replanting Aid Fund (ORRAF) in a project called "Bioplastic Root trainer and Superwaterabsorbent for Increasing Survival Rate of Rubber Implantation". The project was funded by Bureau of the budget with a budget of 15,000 us dollars per year for three years. TINT will supply biodegradable root trainer for using with young rubber plants, and will also supply SWA for using during implantation. ORRAF will be responsible for the rest of project, from locating the suitable field to data collection. The future plan for SWA is to establish cooperation with TINT's Business Development Unit in order to carry out a case study for a business potential to commercialize the super water absorbent for agricultural purposes.

(3) Vietnam (Dr Doan Binh, Vietnam Atomic Energy Agency(VINATOM))

In Vietnam, the study and development of super-water absorbent (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. These SWA is used as a soil humidity conditioning material in agricultural application in arid areas, which was authorized from the Ministry of Agriculture and Rural Development, Vietnam according to a decision No. 55/2006/QĐ-BNN dated July 7, 2006. In addition, there are some studies in VINAGAMMA on the electron beam radiation cross-linking of carboxymethyl starch in the presence of acrylic acid sensitizer to make a friendly environmental biodegradable SWA.

Besides, the UELR-10-15S2 LINAC accelerator (10 MeV, 15 kW) has been put into operation since August 2012. The accelerator was supplied by CORAD Service Ltd., Co, Russia. We have performed the irradiated services such as irradiation of dried fishes, frozen seafood, frozen cut fruits, dried chili, dried onion leaf, some spices, and pet feed; sterilization of medical devices (petri dishes, test tubes, gauze, eye-drop bottle and spatula); and polymeric modification (making nanogel).