ANNEX 2

Part B. Summary of Country Reports on Production of Super water absorbent (SWA) by Radiation Processing

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

The morphological study that is plant height, no. of branch, number of leaves, weight of roots and yield of tomato plant with SWA in soil is higher than that of the soil without SWA. The morphological data of marry-gold with SWA in soil is also higher than that of the soil without SWA.

(2) Indonesia (Ms Ms Tita Puspitasari, National Nuclear Energy Agency (BATAN))

The Super Water Absorbance (SWA) of cassava co acrylate produced by BATAN using gamma irradiation was tested in sandy soil on shallot (Allium Ascalinicum) plant. The purpose of the research is to utilize of SWA cassava co acrylate for the water use efficiency on shallot (Allium Ascalinicum). The experimental design used SWA with the concentration of 0.05, 0.1 and 0.2 g/kg soil. We use three level of watering treatment, first is twice a day of watering; second, twice a week of watering and third, once a week of watering. The land area is 800 m^2 with the number of replicans are 3 times. The oligochitosan and oligoalginate as plant growth promoter also were applied to the shallot plant. The oligochitosan was sprayed once a week while oligoalginate was immersed in the SWA before used.

The experiment was carried out from August to September 2014. The location in Sanden, Bantu District of D.I. Jogjakarta Province.The varieties of shallot crop is Tiren Bantul and soil type is sandy soil.

The results show that the use of SWA cassava starch in sandy soil ,

1. can reduce watering frequency of twice a day (common use of the farmer) to twice a week.
2. shows a significant difference according to Duncan methods on height of plant , tuber diameter of shallot and number of tuber per hill of shallot compared with that of control.
3. The use of SWA in sandy soil on shallot crop is a supporting technology for improved soil moisture and soil amelioration in marginal sand (nutrient-poor) and relatively easy to dryness (very porous soil structure).
4. a combination treatment of SWA with oligochitosan and watering as much as twice a week throughout the shallot crop cultivation gives the best performance

(3) Japan (Dr Naotsugu NAGASAWA, Japan Atomic Energy Agency)

The carboxymethylcelluloses (CMC) are water-soluble polymer so that have been widely used in many industrial applications such as food, medicine and cosmetic fields. Recently, the idea of

synthesis of CMC microscopic gels by means of ionizing radiation has been appeared. The materials are expected for the use to polymeric drugs, drug carriers, cell markers etc. However, in case of diluted CMC aqueous solutions during irradiation, the degradation is the dominant process. In order to solve this problem, we investigated a new method by adding metal ions (NaCl) to CMC solution before irradiation. The Na ions decrease interaction of the charge for CMC molecules and makes coils structure. Therefore, macroradicals formed on such the coiled polymer chains can make possible formation of inter- and intra-molecular crosslinking. Formation of microscopic gels in this system was observed. For 1% CMC with 2 M NaCl during irradiation up to 10 kGy, the storage modulus of CMC gels was moved to higher at low frequency through formation of crosslinking structure of CMC in aqueous solution with NaCl by exposing to ionizing radiation. Because ions of NaCl reduce the mutual interaction of charges on macromolecules and CMC tends to form coils, CMC in aqueous solutions at presence of NaCl during irradiation beside of degradation can undergoes crosslinking. The combination of metal ions addition and radiation-induced crosslinking caused significant synthesis of micro-meter sized carboxymethylcellulose hydrogels.

(4) Kazakhstan (Mr Sergey Kotov, JSC "Park of Nuclear Technologies")

Kazakhstan has 4 industrial scale facilities, which are usable for radiation processing. Three of them are the electron accelerators with energy of 1.5 and 5 MeV. There is also a heavy ion accelerator DC-60, which is used for tracking membrane production. The electron accelerators are used for such product as cross-linked foamed polyethylene, rubber roofing material, heat-shrinkable bands, medical equipment sterilization. Since 2014 Kazakhstan has putted in operation new 5 MeV electron accelerator, which has possibility to produce such products as SWA. Park of Nuclear Technologies has tested production of SWA based on acrylic acid with KOH. In 2015 Kazakhstan is planning to continue SWA project with pot testing and some field testing.

(5) Malaysia (Ms Maznah MAHMUD, Malaysian Nuclear Agency (Nuclear Malaysia))

Nuclear Malaysia has developed super water absorbent (SWA) from sago waste using radiation technology (gamma) and the process has been established. Radiation induces crosslinking as well as grafting in the SWA, which make SWA able to absorb water in high quantity (up to 362g/g) and able to retain the water for certain time. Due to this reason, the application of SWA in agriculture is recommended especially at the poor irrigation area.

Application of SWA on local vegetables was investigated in terms of roots length, plant height and yield. The experiment was done on mustard, Chinese kale and spinach with 3 different contents of SWA i.e. 0.1%, 0.3% and 0.5%. The results indicated that 0.3% SWA give highest value of roots length on mustard and Chinese kale. In contrast, 0.5% SWA exhibits lowest effect on roots length of mustard and Chinese kale. 0.3% SWA and 0.1% SWA give great effect on the height of mustard and

chinese kale, respectively. However, application of SWA on spinach stresses the growth of roots and height of spinach. For Mustard: 0.3% SWA content gives best yield about 48.9% higher than Control. Application of 0.1% SWA and 0.5% SWA stressed the growth of mustard. For Chinese kale: 0.3% SWA gives higher yield compare to Control , but no significant difference compare to 0.1% SWA. 0.5% SWA stressed the growth of Chinese kale. Spinach: Control gives highest yield compare to all SWA treatments. SWA 0.3% shows effectiveness on the growth of mustard and Chinese kale but not in spinach.

Application of SWA on rice also has been carried out using MR 219-4. MR 219-4 is a mutant variety, developed from the irradiation of MR 219 at 300kGy. MR 219 the most chosen variety of Malaysian farmers, highly resistant to disease and requires good water management in order to produce high yield. However, MR 219-4 can survive and produce high yield at minimal water condition.

In this greenhouse test, SWA was introduced to investigate the effect of development of MR219-4 under minimal water supply. 3 different contents of SWA (0.1%, 0.3% and 0.5%) were applied with 1 Control (without SWA) in this study.

From the observation, it shows that 0.1% SWA gives the highest growth rate. On day 42, 0.1% SWA results in 27.7% better growth compare to Control. The Control has displayed least effect on plant growth. It is indicated that the treatment with 0.1% and 0.3% show no significant difference on plant growth whereas 0.5% SWA has low effect on plant growth. SWA treatments also show good effect on tiller production of plant. 0.1% SWA revealed the highest number of tillers, which is almost 2 times higher than the control. All SWA treatment show increment of tiller number between Day 32 and day 42 while without SWA, no significant difference observed. Although 0.5% SWA has low effect on plant height but it shows good result in tiller production. The study will continue until the harvest time to observe whether SWA can give positive effect on yield production or reduce the yield production of the plants.

The application of SWA and its effectiveness on plants need to be studied further in order to support the recent data. In order to expand its application, the promotion and collaboration with other government agency and private sectors which involve in agriculture and plantation should be built intensively and effectively.

(6) The Philippines (Ms Charito T. ARANILLA, Philippine Nuclear Research Institute (PNRI))

The Institute submitted a project proposal for funding by the Department of Science and Technology on the development of polyacrylic acid/kapa-carrrageenan seaweed superwater (PAA/KCSW) absorbent hyrogel for application in agriculture. The raw materials used for SWA were considered for its low cost, easy and low dose processing (10 kGy) and low toxicity after processing. Previous material used for SWA was carboxymethyl-kappa-carrageenan which was replace because its

processing requires chemical derivatization step and high dose (30 kGy) for crosslinking. The newly synthesized PAA/KCSW (5:1 w/w) has a swelling capacity of 900 gram water per gram dry gel. Pot test on the effect of different concentration of PAA/KCSW SWA mixed with sandy soil on the yield of soya beans is on-going. Workplan for the next phase include continuation of the efficacy test of SWA in screen house condition, study biodegradability and conduct field study upon approval of project proposal.

(7) Thailand (Dr Phiriyatorn SUWANMALA, Thailand Institute of Nuclear Technology)

Researchers at TINT performed a field test of SWA with baby corn in Kanchanaburi Province, in the western part of Thailand. The effects of SWA on growth and productivity of baby corn plants were investigated. The results showed that the application of SWA displayed significant effects, statistically, on both height of baby corn plants and weight of baby corn. The productivity increased 44%. SWA could reduce water irrigation. In addition, a pilot plant for the production of SWA with the capacity of 100 kg /day was set up at TINT, Nakorn-Nayok Province. The future plan for this project 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

(8) Vietnam (Dr Nguyen Quoc HIEN, Vietnam Atomic Energy Institute)

Vietnam has stopped their production of SWA due to high production cost.