Summary of Joint Session 1 & 2
FNCA 2016 Workshop on
Biofertilizer and Electron Accelerator Application Project

Joint Session 1 Country Report on Plant Growth Promoter (PGP)
-Electron Accelerator Application Project-

Part 1 Challenges in Commercialization

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

A field experiment was conducted at the yard of Atomic Energy Research Establishment, Savar, Bangladesh during the period from April to July2016 to investigate the effect of foliar application of oligo-chitosan (a growth promoter), on morphological characters, growth, and yield attributes and seed yield of maize plants. Seeds were soaked in 100 ppm oligo-chitosan for 24 hours then sown. Germination was observed after 4 -6 days and first sprayed were applied at seedling stage. The experiment comprised four levels of oligo- chitosan concentrations viz., 0 (control), 50, 75 and 100ppm and every ten days after o-chitosan sprayed up to harvesting. Results revealed that foliar application of chitosan at early growth stages improved the morphological (plant height, leaf number plant-1, leaf length and breadth,), physiological (total dry mass plant-1, absolute growth rate and harvest index) parameters and yield components thereby increased seed yield of maize. The highest seed yield was recorded in 75 and 100ppm of o-chitosan in maize. Therefore, foliar application of oligo-chitosan at 75 ppm may be used at early growth stage for getting maximum seed yield in maize.

1-1-2) Mongolia (Dr Amartaivan Tsenddavaa, National University of Mongolia)

Oligochitosan produced by Vietnam group was used to study the effect on biomass amount and photosynthesis activity of barley. The results were shown that from 40-60 ppm of oligochitosan concentration was more effective.

As raw material for production oligochitosan do not exist in Mongolia, we will not focus on the PGP production but will study about effect of PGP on plant.

1-1-3) Philippines (Mr Fernando Aurigue, Philippines Nuclear Research Institute (PNRI))

The radiation-processed kappa-carrageenan product of the Philippine Nuclear Research Institute has to be registered with the Fertilizer and Pesticide Authority (FPA) to facilitate its commercialization in the Philippines. As Plant Growth Promoter (PGP), the product must be evaluated in large scale first by obtaining an Experimental Use Permit from the FPA and by conducting field trials for at least two seasons in different locations of the country.

Results for rice conducted in farmer's field in five regions (three in Luzon Island, one in

the Visayas, and one in Mindanao Island) indicated 37-64% increase in yield when PGP was applied as foliar spray. This increase in yield is attributed to several reasons that have been observed and documented. However, data for two seasons is not complete in Zamboanga del Sur, Mindanao where rice plants died due to El Niño, and in Cagayan, Luzon because the plants were damaged by the recent typhoon.

For mungbean and peanut, field tests conducted in three regions, all in Luzon Island, resulted in 33-87% increase in yield of mungbean and 18-30% increase in yield of peanut when PGP was supplemented to the Farmer's Practice in the area. The verifiable reasons are stated. Data from the same regions are required for another season and field trials will also be conducted in the Visayas and in Mindanao Island starting 2017.

Moreover, κ-carrageenan PGP will be tested on other crops such as sweet pepper, lettuce, cabbage, broccoli, and strawberry.

Part 2 Achievement of Commercialization and Current state of Eesearch Including New Trials

1-2-1) Indonesia (Dr Darmawan Darwis, National Nuclear Energy Agency (BATAN))

Gamma irradiation was used to prepare oligochitosan by irradiating chitosan at 75 kGy. The initial raw material used is shrimp shell. Oligochitosan was applied as plant growth promoter and plant elicitor for several plants in field tests. The results were as follows:

1. Oligochitosan applied in Allium cepa resulted in:
   a) reduces the use of chemicals fertilizer up to ½ reccommended doses
   b) reduce/no use of fungicide, bactericide, showing that oligochitosan acts as plant elicitor
   c) increases plant height and number of foliage
   d) increase yield up to 26.3%,
   e) Reduce loss on drying
   f) Produce better quality of tuber compared to control, bigger tuber size

2. Oligochitosan was applied in Piper Albi Linn resulted in:
   a) Improve the growth of the main stem. The stem is healthier than control plant
   b) Increase the number of axillary buds
   c) Can cure the plant from disease especialy low to mild degree of Yellow Wilt diseases
   d) The size and weight of pepper berries (peppercorns) of plant treated with oligichitosan is bigger and heavier than control (without oligochitosan)

3. Combined treatment of oligochitosan and biofertilizer for seedling of black pepper.
   Oligochitosan and biofertilizer (superbios) have been used in nursery of black pepper. The results showed that the application of both oligochitosan and biofertlizer results in the faster growing of the seed, reduce mortality, increase number of axillary buds, and

longer main stem. The optimum concentration of oligochitosan used is 50 ppm and 5 g of biofertilizer. Similar results was also found by combination treatment of oligochitosan and biofertilizer for chili plant in semi field test. Oligochitosan and biofertilizer give synergistic effect on plant height, trunk diameter, canopy of chili plant and yield.

1-2-2) Japan (Dr Masao Tamada, National Institutes for Quantum and Radiological Science and Technology (QST))

Research on radiation-induced degradation of polysaccharide such as alginate and chitosan started in 2006FY to prepare environmentally-friendly plant growth promoter (PGP) in Japan. Foliar spray of PGP increased the biomass of leafy green vegetables such as Komatuna and Mizuna. To investigate the effect of molecular weight of degraded polysaccharide on the plant growth, irradiated chitosan was size-exclusively fractionated by ultra-filtration membranes. Molecular weight range from 1 to 3 kDa showed relatively high activity of plant growth which is caused by increment of pathogenesis-rerated proteins such as alcohol dehydrogenase, phenylalanine ammonia-lyase, and chitinase. The PGP made of chitosan was commercialized as plant activator named "Oligoglucosamine-L" in 2009 by financial support of technology transfer promotion program in Japan Atomic Energy Agency after pot and nursery tests of PGP using creeping bent grass for golf course. Especially, the elicitor effect on survival rate of cyclamen was very attractive for commercialization. The survival rate which was reduced to 60 % by fusarium infection maintained the level of 90 %. Challenge of further commercialization of PGP is ongoing by disseminating the advantages of PGP in exhibition and seminar and making technical consultation to initiate collaborative work with end-users.

1-2-3) Malaysia (Dr Marina Binti Talib, Malaysian Nuclear Agency (Nuclear Malaysia))

These environmentally friendly PGP products showed significant enhancement of yield on various crops like rice & chili in field tests. Synergetic effect of PGP and biofertilizer was observed in collaboration with Mutation Breeding Group

i. Application of NM Agronomy Package including oligochitosan, Biofertilizer, Liquid smoke on Mutant rice varieties : (a)-MR 219 (control), (b)-MR 219-9 and (c) MR 219-4

ii. Treatment:
1-Bioliquidfert + Liquid smoke
2-Oligochitosan (100 ppm) + Liquid smoke
3-Bioliquidfert + Oligochitosan (100 ppm) + Liquid smoke
4-Control (Farmer pracrtice)

The data collected during field test has shown no synergy effects between biofertilizer and oligochitosan. Further study on response of rice to combination treatment (biofertilizer and oligochitosan) and single treatments (biofertilizer or oligochitosan only) is highly important in order the study the synergy effect in towards enhancing the growth or yield of rice. More experiments to investigate synergism are in progress and planned.

Production of Super water absorbent (SWA) by radiation processing is still in pot test for onion in sandy soil condition.

1-2-4) Thailand (Dr Phyriyatorn Suwanamala, 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 field test of SWA with Asparagus in Lopburi Province, in the central region of Thailand. The effects of SWA on growth of Asparagus was investigated. The results showed that the application of SWA displayed significant effects, statistically, on height of Asparagus plants. SWA could reduce water irrigation.

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 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

1-2-5) Vietnam (Dr Nguyen Quoc Hien, Vietnam Atomic Energy Institute (VINATOM))

Effect of foliar spraying oligochitosan (Mw ~5.000 g/mol) and mixture of oligochitosan/nanosilica on seed yield of soybean (Glycine max L.) was studied. The seed yield of soybean increased 10.5 and 17.0 % for oligochitosan (50 mg/L) and

oligochitosan/nanosilica (50 mg/L:50 mg/L), respectively. The net profit of using oligochitosan and oligochitosan/nanosilica as growth promoter for soybean was preliminarily calculated to be about 120 USD and 220 USD/ha, respectively compared to the control treated with water. Effect of oligochitosan on tissue culture of orchid plant (Dendrobium sonia white) was also studied. Results showed that the weight of protocorm-like bodies in liquid medium increased about 21 times at the optimal concentration of 20 mg/L compared with 11 times of the control without oligochitosan treatment. Furthermore, the generation of 5.3 plantlets from protocorm in the presence of 15 mg/L oligochitosan in solid agar medium compared to 1.5 plantlets of the control. Thus, oligochitosan exhibits effective plant growth promotion for soybean and orchid plant tissue. In addition, effect of oligochitosan supplementation on growth and disease resistance of striped catfish (Pangasianodon hypophtalmus) was also investigated. Results indicated that weight gain of 100 ppm oligochitosan supplemented catfish increased about 18 % compared with the control (not supplemented with oligochitosan). Large farm trial of the effect of oligochitosan on weight gain of ~500,000 catfish in Mekong Delta area has been being tested.

Joint Session 2 Report of Synergy Effect on Biofertilizer and PGP

-Biofertilizer Project-

2-1) Bangladesh (Dr Md Kamruzzaman Pramanik, Bangladesh Atomic Energy Commission (BAEC))

Synergistic Effect of Oligo-chitosan and Biofertilizer on Rice Plants

Pot experiment was carried out to observe the synergistic effect of plant growth promoter (oligo -chitosan as PGP) and Biofertilizer (BF) along with chemical fertilizer (CF) on rice plants. Rice plants (BIRRI-29) were treated with single different treatment (viz, Chemical Fertilizer, oligochitosan 50/100ppm and BF, separately) and combined treatment (viz. CF with/without urea+BF, CF with/without urea+oligochitosan-50/100 ppm and CF with/without urea + oligo chitosan50/100 ppm + BF).

All of the single treatments showed positive effect in terms of leaf number, plant height, tiller and panicle number per pot in comparison to control. Among the single treatments, the highest leaf no. found in the pot treated with 100 ppm oligochitosan, the highest plant height found in the pot treated with 50ppm oligochitosan and the highest tiller and panicle no found in pot treated with BF.

Combined treatments with CF with/without urea + oligochitosan 50/100ppm showed positive effect in terms of plant height, tillers and panicle number with compare to control. In these combinations, the highest plant height was found in the pot treated with CF without urea+100 ppm oligochitosan. The highest tiller and panicle number were counted

in the pot treated with CF with urea + 100ppm oligochitosan.

Combined treatments with CF with/without urea + BF also showed better result with respect to all of the parameters in comparison to control. Both the combination treatments (CF with urea + BF and CF without urea + BF) produced same effect with respect to tiller and panicle number.

Combined treatments with CF with/without urea + oligochitosan50/100 ppm + BF also produced improved result in terms of all parameters with compare to control. In these combinations, highest no of leaves, tiller and highest plant height were found in the pot treated with combination of CF with urea + 100ppm oligochitosan + BF. Though these combined treatments (CF with/without urea + oligochitosan50/100 ppm + BF) rendered positive impact on rice plants in comparison to control, synergistic effect was found insignificant in comparison to other (single & combined) treatments. The work is ongoing as the yield of rice is not harvested yet.

2-2) China (Dr. Fan Bingquan, Chinese Academy of Agricultural Sciences (CAAS))

We conducted pot experiment on synergistic effect of oligo-chitosan and biofertilizer on maize in 2016.

Materials Methods: The concentration of oligo-chitosan was used at a rate of 300mg/kg soil, chemical fertilizer was used at a rate of N 100mg/kg,P_2O_5 75 mg/kg and K_2O 50mg/kg soil. The chemical fertilizer and biofertilizer (at a rate of 5g/pot, 2×10^8cfu/g) was thoroughly mixed with soil. The oligo-chitosan solution was put into the soil under the seeds.

Results: The results showed that oligo-chitosan can increase the maize biomass weight significantly than control. the oligo-chitosan treated with Co-60 irradiation have got higher maize biomass increased 42.6% at a irradiation dose of 20 kGy and 41.5% at a irradiation dose of 75 kGy. The non-irradiated chitosan also got a higher biomass yield of 41.3% than control (Table 1). There was a positive effect between oligo-chitosan and biofertilizer. The maize biomass in treatment of oligo-chitosan with biofertilizer Y16 was increased markedly than control. Oligo-chitosan irradiated with 75 kGy achieved a highest biomass increased 54.4%, the second highest biomass of maize was in treatment 20 kGy irradiation with 42.5% increase (Table 2). The result showed that maize biomass in treatment of oligo-chitosan with biofertilizer Y16 have been increased even chemical fertilizer applied in soil. That means chemical fertilizer can be used with bifertilizer and oligo-chitosan (Table 3).

Table 1. Effec of irradiation doses of chitosan on maize biomass (g/pot)

Treatment	Oligochitosan treated with Co-60 irradiation doses (kGy)							
	0	20	35	50	75	100	200	300

Control	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2
Oligo-chitosan (300ppm)	24.30	24.53	17.12	19.04	24.34	22.09	20.93	24.10
Increase %	41.3	42.6	-0.5	10.7	41.5	28.4	21.7	40.1

Table 2. Synergistic effect of oligo-chitosan with biofertilizer Y16 on corn biomass (g/pot)

Treatment	Oligochitosan at irradiation doses (kGy)							
	0	20	35	50	75	100	200	300
Inoculum Y16 （CK）	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91
Inoculum Y16+ oligochitosan (300ppm)	23. 51	24.11	23.74	20.25	26.11	21.66	20.67	20.75
Increase %	39.03	42.5	40.4	19.7	54.4	28.1	22.2	22.7

Table 3. Effect of oligo-chitosan with biofertilizer Y16 under chemical fertilizer condition on maize Biomass (g/pot)

BF	CF (N-P-K)	Chitosan (ppm)	Fresh WT **(g/pot)**	BF	CF (N-P-K)	Chitosan (ppm)	Fresh WT **(g/pot)**
Y16	0	0	17. 49	C2	0	0	21.87
Y16	100-75-50	0	23. 16	C2	100-75-50	0	23.85
Y16	100-75-50	300	25. 79	C2	100-75-50	300	25.61

* BF stand for biofertilizer, CF stand for Chemical fertilizer.

2-3) Indonesia (Prof. Dr Iswandi Anas, Bogor Agricultural University (IPB))

Oligochitosan and biofertilizer have been reported to increase growth and yield several crops. The objective of this study was to evaluate the synergic effect of Oligochitosan and Bio-organic fertilizer Super Biost to improve growth and yield of chili.

Materials Methods:

Chili cultivar　PM 999 F1, Inorganic fertilizers standard dosage Urea (200 kg), ZA (500 kg) SP-36 (400 kg) and KCl (200 kg) per hektar, Oligochitosan produced by Batan (0-25-50 ppm), Bio-organic fertilizer Super Biost (0-10 -20 g/plant)

Table 1. Treatments of the research

No	Treatment	Description
1	Recommended Dosage	Urea (200 kg), ZA (500 kg), SP36 (400 kg), dan KCl (200 kg) per ha
2	K_0B_0	75% recomendation dosage + without oligochitosan and Super Biost
3	K_0B_1	75% recomendation dosage + 0 ppm oligochotosan and 10 gram Super Biost
4	K_0B_2	75% recomendation dosage + 0 ppm oligochitosan and 20 gram Super Biost
5	K_1B_0	75% recomendation dosage + 25 ppm oligochitosan and 0 gram Super Biost
6	K_1B_1	75% recomendation dosage + 25 ppm oligochitosan and 10 gram Super Biost
7	K_1B_2	75% recomendation dosage + 25 ppm oligochitosan and 20 gram Super Biost
8	K_2B_0	75% recomendation dosage + 50 ppm oligochitosan and 0 gram Super Biost
9	K_2B_1	75% recomendation dosage + 50 ppm oligochitosan and 10 gram Super Biost
10	K_2B_2	75% recomendation dosage + 50 ppm oligochitosan and 20 gram Super Biost
11	K_3B_0	75% recomendation dosage + 100 ppm oligochitosan and 0 gram Super Biost
12	K_3B_2	75% recomendation dosage + 100 ppm oligochitosan and 10 gram Super Biost
13	K_3B_3	75% recomendation dosage + 100 ppm oligochitosan and 20 gram Super Biost

Results:

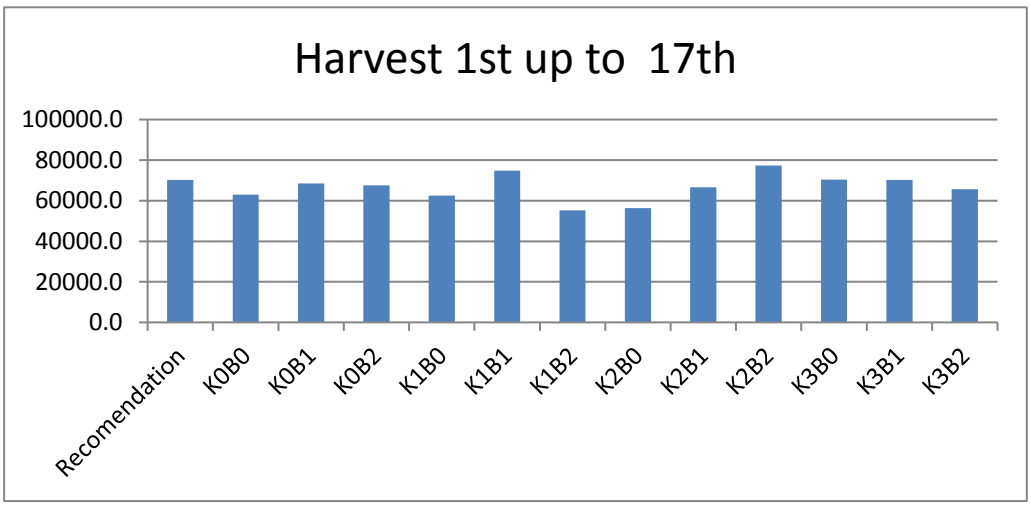
Table 2. Cumulative yield after 6th harvests

No	Treatments	Plant Yield						Weight(g)
		1	2	3	4	5	6	
1	Recommeded dosage	33.66	194.12	1923	1400	3251	3351	10153
2	K0B0	49.54	194.26	1658	1123	3180	3378	9583
3	K0B1	133.22	517.06	2096	2032	3501	4083	12362
4	K0B2	23.28	456.38	2378	1713	3154	3741	11466
5	K1B0	62.91	358.33	4412	1812	3199	3465	13309
6	K1B1	38.22	292.7	2072	1962	3539	4427	12331

7	K1B2	122.02	481.19	2241	1668	2997	3129	10638
8	K2B0	56.04	297.44	1852	1424	2778	3185	9592
9	K2B1	29.35	423	1750	1443	2608	3772	10025
10	K2B2	142.52	590.24	2883	1955	3610	4956	14137
11	K3B0	87.34	442.52	2118	1667	2887	3450	10652
12	K3B1	222.72	554.7	2293	1999	3337	4730	13136
13	K3B2	113.6	351	1943	1700	3143	4149	11400

Table 3. Cumulative yield after 17th harvests

No	Treatments	Plant Yield (g)			
		1 s/d 5	1 s/d 10	1 s/d 15	1 s/d 17
1	Recommeded dosage	6801.8	47786.8	69536.8	70218.8
2	K0B0	6204.8	42925.8	62375.7	62931.7
3	K0B1	8279.3	52263.3	67916.3	68469.3
4	K0B2	7724.7	46832.7	67013.7	67596.7
5	K1B0	7344.2	44203.2	61939.2	62447.2
6	K1B1	7903.9	55319.9	74286.9	74788.9
7	K1B2	7509.2	39487.2	54657.2	55175.2
8	K2B0	6407.5	38931.5	55764.5	56338.5
9	K2B1	6253.4	45075.4	66372.5	66641.5
10	K2B2	9180.8	57230.8	76064.0	77385.0
11	K3B0	7201.9	52998.9	69339.4	70412.4
12	K3B1	8406.4	52434.4	69404.4	70302.4
13	K3B2	7250.6	50186.6	65290.5	65582.5



Conclusions:

1. There was a sinergyc effect of oligochitosan and bio-organic fertilizer on growth and yield of chilli.
2. Application of 50 ppm of oligochitosan in combination with 20 g of bio-organic fertilizer Biost gave the highest yield of fresh chili.

2-4) Japan (Dr Shotaro Ando, Japan International Research Center for Agricultural Sciences (JIRCAS))

Chitosan is a linear polysaccharide composed of β-(1-4)-linked D-glucosamine. Oligochitosan is a low molecular weight chitosan and it can be obtained by γ-ray irradiation to chitosan. It has the effect of promoting the growth of plants such as rice, barley and soybean.

We studied synergy effect of bio-pesticide and oligochitosan plant growth promoter (PGP). "Live coat" contains *Pseudomonas fluorescens* strain FPH9601 and it covers tomato seed. Oligochitosan treated alone did not affect the germination and growth of tomato seedlings and could not suppress the occurrence of tomato bacterial wilt. In the case of combination with oligochitosan and "Live coat", the suppression effect against tomato bacterial wilt did not increases along with oligochitosan concentration, when tomato seeds with "Live coat" were sown and oligochitosan was applied at the same time.

But, when seedlings were treated with oligochitosan at 1 day before transplant to soil contaminated by the pathogen, suppression effect against the pathogen was much higher than those that were treated oligochitosan or "Live coat" individually.

Similar synergistic effect was shown in the field experiment, too. Tomato seeds were treated by *Pseudomonas fluorescens* strain FPH9601 and seedlings were sprayed by oligochitosan after transplanting. It was suggested that oligochitosan induced resistance to seedling treated with bio-pesticide.

2-5) Malaysia (Ms Rosnani Binti Abdul Rashid, Malaysian Nuclear Agency (Nuclear Malaysia))

Malaysia reported on effects of biofertilizer and oligochitosan on several crops – leafy vegetables (*Brassica* spp.), ornamental plant (hibiscus) and rice grown in greenhouses under controlled conditions. *Brassica* sp. plants given single treatment of biofertilizer only had higher plant biomass and length of roots in comparison to the oligochitosan only and biofertilizer + oligochitosan treatment. For the leafy vegetable experiments, chemical fertilizer gave the best results in terms of plant biomass amongst the treatments. Plant with biofertilizer supplemented with oligochitosan treatment showed some response on length of roots of kailan, *Brassica oleracea* var. Alboglabra. *Brassica* sp. However, plant with oligochitosan only treatment showed a good response in terms of size of leaf as compared to other treatments. The experiment is still in progress; N-15 isotope data of the plants will provide insight of the N nutrition of kalian in the presence of biofertilizer and plant growth promoter. From the study on hibiscus, mutants treated with Bioliquifert only and Bioliquifert + oligochitosan have taller plant height and darker green leaves. Plant treated with oligochitosan are lesser infested by whitefly. The dry weight of root, stem and leaves of hibiscus mutants with Bioliquifert only treatment showed higher compared to others treatment. The synergy effects between biofertilizer and oligochitosan was not clearly shown in the case of rice. There is still a need for further study on response of rice to combination treatment (biofertilizer and oligochitosan) and single treatments (biofertilizer or oligochitosan only). Generally, there is not much evidence of synergy effects between biofertilizer and oligochitosan; often biofertilizer or oligochitosan single treatment resulted in enhanced growth or yield effects. More experiments to investigate synergism are in progress and planned.

2-6) Thailand (Dr Phatchayaphon Meunchang, Department of Agriculture (DOA))

Biofertilizer is fertilizer containing of living microorganism that are able provide essential mineral to crop by fixing nitrogen from atmosphere or increase availability of mineral uptake into the crop. In 2013, we started the experiment on sterile carrier, which was developed by using gamma irradiation for improving PGPRs biofertilizer production. The result found that carrier from materials mixed of acid sulfate soil and wood bark compost

were kept survival of *Azospirillum brasilense* (TS29) and *Burkhoderia vietnamensis* (S45) higher than the minimum population limited in fertilizer act of Thailand (at less 10^6 cell g^{-1}) more than 6 months.

PGP is the plant growth promoter substances, it promote plant growth by direct and indirect functional. oligochitosan is product containing oligopolymer, it is not clear mechanism on promote plant growth. It might function as the elicitation.

The field experiment was conducted in sandy soil at Northeast of Thailand. The experimental design was in RCBD with 4 replications of 6 treatments consisted of 1) 100% chemical fertilizer, 2) 75% chemical fertilizer, 3) 75% chemical fertilizer + PGPR, 4) 75% chemical fertilizer + oligochitosan, 5) 75% chemical fertilizer + PGPR + oligochitosan, 6) control (non fertilization) Soil fertility was analyzed for recommend the chemical fertilizer.

The result showed that the experiment on rice variety Jasmine 105, the treatment 100% chemical fertilization did not significant increased rice yield different from control non fertilization treatment. Effect of PGPR biofertilizer and oligochitosan did also not respond on increase rice yield in this experiment. This due to Jasmine rice 105 variety did not much respond to the fertilization. However, trend of synergic effect of biofertilizer and oligochitosan was showed in this experiment on decreased fertilization for 25% from 100% rate. But applicant of PGP or PGPR biofertilizer alone did not respond on increase yield. We are confirm this experiment on rainy season of 2016.

2-7) Vietnam (Dr Pham Van Toan, Vietnam Academy of Agricultural Sciences (VAAS)

The research on synergistic effect of Oligo-chitosan and Biofertilizer concern on testing the effect of Oligo-chitosan on survival of beneficial microbes and plant pathogen microbes, the effect of Oligo-chitosan on the nutrition uptake by cabbage and testing the synergistic effect of Oligo-chitosan and Biofertilizer on the root disease of tomato, cabbage as well as the effect of growth of maize. The results showed, that Oligo-chitosan had no negative effect on growth of beneficial microbes and plant pathogen bacteria, but could inhibit the growth of plant pathogen fungi. Synergistic effect of Oligo-chitosan and Biofertilizer was found in the experiments with cabbage and tomato relating to the bacterial wilt disease control. The synergistic effect of Oligo-chitosan and Biofertilizer was not significant relating to the nutrition uptake by plant and plant yield.