Annex 4 Summary of Joint Session 1, 2 & 3

Summary of Joint Session 1, 2 & 3
FNCA 2017 Workshop on
Biofertilizer and Electron Accelerator Application Project

Joint Session 1 Joint Session 1 Country Report on Challenge and progress for commercialization of Plant Growth Promoter
-Electron Accelerator Application Project-
1) Bangladesh (Dr Salma Sultana, Bangladesh Atomic Energy Commission (BAEC))

1. Effect of foliar spray of oligo- chitosan on maize plant (*Zea mays* L)

Two field experiments were conducted in two consecutive years during the period from April to July, 2016 and June to September, 2017(off-season), to investigate the effect of foliar application of o-chitosan concentrations viz., 0(control), 50, 75 and 100ppm. The chitosan was sprayed ten days interval up to harvesting. Results revealed that foliar application of o-chitosan at early growth stages improved the morphological (plant height, leaf number plant-1, leaf length and breadth), harvest index and yield components thereby increased seed yield of maize. The highest seed yield was recorded both year (2016 and 2017) in 75 and 100 ppm of o-chitosan in maize. Due to off-season the % yield of maize in 2017 is lower compared to 2016. In 2016 the average yield of maize at 75 ppm and 100 ppm showed 16.86kg and 15.54 kg per plot and the percent yield over control at 75 and 100ppm showed 43.73 and 32.48 where as in 2017, the average yield of maize at 75 ppm and 100 ppm showed 4.10 kg and 3.95 kg per plot and the percent yield over control at 75 and 100ppm showed 51.85 and 46.30 respectively. In both years the highest yield was recorded in75 ppmo-chitosan in maize. Therefore, foliar application of o-chitosan at 75 ppm may be used for getting maximum seed yield in maize.

2. Application of oligo- chitosan as plant growth promoter on Egg-plant (Solanum melongena L.)

Bangladesh during the period November 2016 to March 2017to investigate the effect of o-chitosan application on morphological characters, growth and economic yield in egg-plant. The experiment comprised four levels of o-chitosan concentrations viz., 0 (control), 50,75 and 100 ppm. The chitosan was sprayed ten days interval up to harvesting .Effects of oligo-chitosan on egg-plant growth and productivity were investigated in terms of plant height, total number of egg-plant, total weight of egg-plant, harvest time and weight per egg-plant. The results showed that the foliar application of o-chitosan, at the concentration of 50 and 75 ppm displayed significant effects. The results showed that productivity was increased up to 40 and 48% over control at 50 and 75 ppm respectively. . The o-chitosan also shows the ability to shorten the harvest time of egg-plants with compare to control. These results suggest that foliar application of o-chitosan at 75 ppm is optimum for maximizing plant growth and higher yield for egg-plants.

3. Combined application of Chitosan, Rhizobium Biofertilizer and Chemical Fertilizers produced synergistic effect on Soybean (Glycine Max)

Pot experiment was carried out to study combined effect of chitosan and *Rhizobium* biofertilizer on nodulation, dry matter production and yield of soybean (variety BARI Soybean-6). A total of 14 treatments were applied with the combination of different concentration of chitosan (viz. 50, 100 and 150ppm) and different amount of chemical fertilizer (50, 75 and 100%) along with biofertilizer. The experiment was designed in RCB with 3 replications and several parameters including plant height, root and shoot weight, stover and seed yield were considered for assessment if combined or synergistic effect of chitosan and biofertilizer is present upon using these combinations. The highest plant height (74.1 cm) was found in T_{11}-treatment (50% chemical fertilizer plus 50ppm chitosan plus biofertilizer). Maximum root weight was observed in T_{10}-treatment (75% chemical fertilizer plus 150ppm chitosan plus biofertilizer). The highest pods/plant and shoot weight were observed in T_5-treatment (50% chemical fertilizer plus 50ppm chitosan) and that were 33.5 and 10.36 g/plant, respectively. The highest no. of seeds/pod, nodule weight, stover yield were observed in T_9-treatment (75% chemical fertilizer plus 100ppm chitosan plus biofertilizer) and that were 2.4 no, 18.65 mg/plant, and 6.63 g/plant respectively. Interestingly, the most important parameter, highest seed yield (3.15g/plant) was also observed in the same treatment (T_9) with increased yield by 24.90%. The result indicated that combined use of chemical fertilizer (75%), chitosan (100ppm) plus biofertilizer rendered the highest nodulation, dry matter production and yield of soybean indicating their synergistic activity on soybean.

4. Development of "Synergy Biofertilizer" in combination with Chitosan for Rice Plants

A semi-field level experiment was carried out to study combined effect of chitosan as PGP and *Azospirillum* species as biofertilizer on rice plant. Six treatments were applied with triplicates viz, T_1: 100% chemical fertilizer, T_2: 50% chemical fertilizer, T_3: 50% chemical fertilizer +100ppm chitosan, T_4: 50% chemical fertilizer +100ppm chitosan+ biofertilizer, T_5: 50% chemical fertilizer + biofertilizer and T_6: Control (native nutrient). Rice variety, BRRI-129 was selected as test rice variety and several parameters including tiller height and number, panicle length and grain yield were assessed to determine if any synergy effect of chitosan and biofertilizer is present. Result showed that the highest tiller height (103.67 cm) was found in T_1–treatment and no synergy was found with respect to this parameter. The highest tiller number (22.23 tillers/hill) was found in T_1 –treatment and second highest reading (21.4 tillers/hill) was found in T_4-treatment with 12.8% increase of tiller no. (with respect to T_2-treatment). Panicle no. was almost unaffected with any treatment. No synergistic effect of PGP and biofertilizer was found in straw weight. Grain size was increased upto 3.68% in the T_4-treatment as measured by 1000-grain weight. Grain yield of rice (t/ha) was increased up to 12.18% in T_4–treatment which can be considered as synergistic effect of PGP and biofertilizer because the combined effect of PGP and biofertilizer is greater than the sum of individual effect of PGP (4.49 %increase) and biofertilizer (3.7% increase). Overall results indicate that

integrated use of chitosan (100ppm) plus biofertilizer along with (50%) chemical fertilizer has synergistic effect on rice plant.

2) Mongolia (Mr Sukh Odkhuu, National University of Mongolia)

A field test was carried out at Darkhan-uul province which is located 200km far from Ulaanbaatar, period was June to August, 2017.

O-chitosan produced in Malaysia was used to study the effect on biomass amount and yield of wheat and potato. Tested three different concentration of chitosan such as a 50, 100 and 150 ppm and sprayed three times until harvesting. The result were shown that 50 ppm of chitosan concentration was more effective on wheat and 100 ppm of chitosan on potato.

Yield of wheat with 50 ppm chitosan was 55% higher than control and the mass of 1000 seeds was 3% higher than control. The average height of straw with 50 ppm chitosan was 20% taller than others.

Forecast yield of potato with 100 ppm chitosan was 9.5 ton per 1 Ha which was 38% higher than control.

Joint Session 2 Country Report on new trials after commercialization of PGP
-Electron Accelerator Application Project-

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

Oligochitosan (o-chitosan) was prepared from chitosan by gamma irradiation. O-chitosan is used for plant growth promoter (PGP), plant elicitor, and antibiotic agent and for animal feed nutrition as well. In 2017, o-chitosan was used to pepper (piper nigrum) plant in the early stage of planting to evaluate the plant growth. It was also used to treat diseases such as Phytophthora disease and slow decline. In addition, o-chitosan also used to evaluate the yield of pepper. Another application of o chitosan is animal feed supplement. Cihateup duck traditionally managed under minimum water condition resulted in heat stress of duck. This condition resulted in low productivity. O-chitosan was used to Cihateup duck which is traditionally managed under minimum water condition to study the effects of dietary chitosan on blood biochemical properties, and growth performance. The results show that in the early state of planting up to 3 months DAP, piper nigrum plants treated with o-chitosan have bigger size of the circumference of climbing shoots and increase number of climbing shoots. O-chitosan with concentration of 150 ppm is effective to cure diseases such as Phytophthora foot rot and slow decline caused by fungi. O-chitosan increases the pepper yield, size and individual weight of berries; reduce the pathogenic microbes contaminants (Salmonella, E. Coli), light berries and moisture content. As animal feed supplement, o-chitosan improve quality of blood biochemical such as blood glucose content, triglycerides, blood cholesterol, total protein, urea, and albumin. It also improves duck's performance such as increased body weight, reduces Feed Conversion Ratio (FCR) and feed consumption, and increase egg weight.

4) Japan (Dr Mitsumasa Taguchi, National Institutes for Quantum and Radiological Science and Technology (QST))

Oligo-chitosan, which is produced from chitosan (3%) in 1.5% lactic acid solution by γ-ray irradiation at 100 kGy, is an effective plant growth promoter. Oligo-chitosan was newly applied for Bonsai, which is Japanese art form using tree in container and is popular worldwide. Polytrichum juniperinum (Sugigoke moss) and Racomitrium canescens (Sunagoke moss), which decorate the soil of Bonsai, were sprayed with 100-ppm oligo-chitosan once a week for 1 month as a pot test. The growth effects are currently being analyzed. It also becomes a measure against the heat island effect by growing moss on the roof of house/building.

5) Malaysia (Dr Marina Binti Talib, Malaysian Nuclear Agency)

After commercialization of oligochitosan as plant growth promoter in agricultural industry, Malaysia is looking forward to study the new application of oligochitosan. First project is to use oligochitosan as animal feeding, which started in November 2017 until May 2018. The objective of this collaboration project is to increase revenue of Cooperation of Agriculture, Kedah and corn farmers from 25 to 40 tonnes/month. Another project is to develop new plant growth promoter from new indigenous product; kappa carrageenan. This involves modification of carrageenan through degradation using gamma irridiation of 25-125kGy. The effect of radiated carrageenan was investigated based on pH, molecular weight, viscosity, and FTIR. Another project is CarraDish: a new low cost system for culturing 3 Dimensional (3D) Cells prepared from radiated carrageenan. The research and development involves formulating and fabrication of CarraDish with similarity property to agarose. The ongoing project will study the quality and quantity of cells harvested from CarraDish.

6) Philippines (Dr Lucille V. Abad, Philippines Nuclear Research Institute (PNRI))

Radiation modified carrageenan has been tested as Plant Growth Promoter. It has proven to be effective in rice, mungbean and peanuts increasing yield by 20-30% for rice and 15-35% for both mungbean and peanuts. Carrageenan PGP has benefitted more than 1,000 farmers as applied to a total rice field area of more than 5,000 ha., increasing crop yield by an average of 27% both during dry and wet season.

The initial challenge is to increase production of Carrageenan PGP to commercial scale. The institute (PNRI) has the only Cobalt-60 gamma irradiator in the Philippines. With its current activity of only 56 kCi, this can only irradiate a total volume of approximately 1,700L in four (4) days. Parameters for the irradiation of the PGP carrageenan by E-beam has been optimized to produce a volume of as much as 1,700 L/ hr.

Currently, three technology adopters have signed a licensing agreement with PNRI. Product registration with the Fertilizer and Pesticide Authority (FPA) has already been obtained. Production will initially be done at the institute after securing the License to

Operate (LTO) permit from FPA. The three technology adopters in the meantime are securing their Distributorship License also from FPA. It is expected that within three years after initial commercial production, the adopters will set up their own irradiation facility.

7) Thailand (Dr Phyriyatorn Suwanamala, Thailand Institute of Nuclear Technology (TINT))

Chitin is prepared from local shrimp shells by the Thailand Institute of Nuclear technology (TINT). The prepared chitin is changed into chitosan by chemical reaction. Radiation-induced degradation is used to reduce the molecular weight of the prepared chitosan, yielding oligochitosan. In 2017, an up-scaled production plant of PGP with a capacity of 100,000 liters /day was set up at the TINT Thai Irradiation Center, Prathumthanee Province. The PGP was purchased by PDA, a private company.

8) Vietnam (Dr Nguyen Ngoc Duy, Vietnam Atomic Energy Institute (VINATOM))

The preparation of oligochitosan through the heterogeneous degradation of chitosan/H_2O_2 combined with the homogeneous reaction of chitosan with H_2O_2 under gamma radiation was presented. Oligochitosan with weight-average molecular weight (Mw) of less than 10 kDa could be efficiently prepared by gamma Co60 irradiation of chitosan solution (4%) and hydrogen peroxide (0.5%) at doses ranging from 8 to 24 kGy. The effect of foliar application of the mixture of OC-nSiO2 on the induction of resistance against anthracnose disease caused by Colletotrichum gloeosporioides fungus on chili fruits was investigated. Results indicated that foliar application of OC-nSiO2 with the concentration of 60 mg/l - 60 mg/l was found to be as the optimal treatment that reduced the disease severity on chili fruits to 22.2% compared with 90.0% of the control. Effect of foliar application of oligochitosan and oligochitosan-nanosilica on soybean seed yield was conducted in experimental field. Results indicated that soybean seed yield increased 10.5 and 17.0% for oligochitosan and oligochitosan-nanosilica, respecttively for the control. In addition, effect of oligochitosan supplementation on growth and disease resistance of striped catfish (Pangasianodon hypophtalmus) was also investigated in pond culture. The results indicated that the growth performance and survival rate of striped catfish fed with 100 mg COS/kg were significantly improved and the FCR decreased. The average weight gain, survival rate and FCR of striped catfish fed with diets containing COS were 971 ± 18 gram, 83.19 ± 0,35 % and 1.477 ± 0,013 in comparison with 896 ± 6 gram, 78.43 ± 0,64 % and 1,578 ± 0,038 of control group, respectively.

Joint Session 3 Report of Synergy Effect on Biofertilizer and PGP

-Biofertilizer Project-

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

Development of "Synergy Biofertilizer" in combination with Chitosan for Rice Plants

A semi-field level experiment was carried out to study combined effect of chitosan as PGP and *Azospirillum* species as biofertilizer on rice plant. Six treatments were applied with triplicates viz, T_1: 100% chemical fertilizer, T_2: 50% chemical fertilizer, T_3: 50% chemical fertilizer +100ppm chitosan, T_4: 50% chemical fertilizer +100ppm chitosan+ biofertilizer, T_5: 50% chemical fertilizer + biofertilizer and T_6: Control (native nutrient). Rice variety, BRRI-129 was selected as test rice variety and several parameters including tiller height and number, panicle length and grain yield were assessed to determine if any synergy effect of chitosan and biofertilizer is present. Result showed that the highest tiller height (103.67 cm) was found in T_1–treatment and no synergy was found with respect to this parameter. The highest tiller number (22.23 tillers/hill) was found in T_1 –treatment and second highest reading (21.4 tillers/hill) was found in T_4-treatment with 12.8% increase of tiller no. (with respect to T_2-treatment). Panicle no. was almost unaffected with any treatment. No synergistic effect of PGP and biofertilizer was found in straw weight. Grain size was increased up to 3.68% in the T_4-treatment as measured by 1000-grain weight. Grain yield of rice (t/ha) was increased up to 12.18% in T_4–treatment which can be considered as synergistic effect of PGP and biofertilizer because the combined effect of PGP and biofertilizer is greater than the sum of individual effect of PGP (4.49 %increase) and biofertilizer (3.7% increase). Overall results indicate that integrated use of chitosan (100ppm) plus biofertilizer along with (50%) chemical fertilizer has synergistic effect on rice plant.

2) China (Dr Zhang Ruifu, Chinese Academy of Agricultural Sciences (CAAS))

Synergistic effect of Oligo-chitosan combined with Y16 biofertilizer

There was a positive effect between oligo-chitosan and biofertilizer. The corn biomass in treatment of oligo-chitosan with biofertilizer Y16 was increased markedly compared with control. Oligo-chitosan irradiated with 75 kGy achieved a highest biomass averaged 54.4g/pot, the second highest biomass of corn in treatment of 20 kGy irradiation was 42.5 g/pot.

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

Treatment	Oligo-chitosan treated with Co-60 irradiation doses (KGy)							
	0	20	35	50	75	100	200	300
Y16（CK）	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91
Y16+oligochitosan (30 mg/pot)	23. 51	24.11	23.74	20.25	26.11	21.66	20.67	20.75
Increasing (%)	39.03	42.5	40.4	19.7	54.4	28.1	22.2	22.7

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

Oligochitosan and biofertilizer have been reported to increase growth and yield several crops. 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.

For the materials, chili cultivar PM 999 F1, Inorganic fertilizers standard dosage Urea (200 kg), ZA (500 kg) SP-36 (400 kg) and KCl (200 kg) per hectare, Oligochitosan produced by Batan (0-25-50 ppm), Biofertilizer Super Biost (0-10 -20 g/plant) (Bio-organic fertilizer) were used.

There was a synergy effect of oligochitosan and bio-organic fertilizer on growth and yield of chilli. Application of 50 ppm of oligochitosan in combination with 20 g of bio-organic fertilizer Biost gave the highest yield of fresh chili. This means that the rate of inorganic fertilizer can be replaced by bio-organic fertilizer Biost without reducing the yield.

4) Japan (Dr Shotaro Ando, Japan International Research Center of Agriculture Science (JIRCAS))

Chitosan is a linear polysaccharide composed of ß-(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.

The preventive effect of rice blast disease by *Bacillus pumilus* TUAT1 inoculation was investigated in Fukushima paddy field. Blast is a serious disease of rice caused by *Magnaporthe oryzae* B., etc. Lesion of the blast, which was formed on leaves of rice, was evaluated. Spore formulation inoculation decreased the average lesion area ratio significantly. It can be one of the examples to evaluate synergy effect on biofertilizer and

PGP in the field.

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

Malaysia reported on effects of biofertilizer and oligochitosan on several crops – chilli (*Capsicum annum*), okra (*Abelmoschus esculentus*) and banana under controlled conditions. For the experiments of chilli and okra, five treatment was used i) 100 % chemical fertilizer, ii) 50 % chemical fertilizer and biofertilizer, iii) 50 % chemical fertilizer and oligochitosan, iv) 50 % chemical fertilizer, biofertilizer and oligochitosan and v) 50 % chemical fertilizer. From the chili experiment, treatment of 50 % chemical fertilizer and biofertilizer gave the best result in terms of height of plant compared to other treatments. On the other hand, the growth of plant with chemical fertilizer supplemented with biofertilizer and oligochitosan in terms of plant height was the lowest. For the study on okra, plant with chemical fertilizer supplemented with biofertilizer or oligochitosan showed highest root length and biomass. Plant with chemical fertilizer with biofertilizer and oligochitosan treatment showed no good response on root length and biomass. The synergy effects of biofertilizer and oligochitosan on banana is still on-going. Generally, not much synergy effects between biofertilizer and oligochitosan are being clearly observed in our chilli and okra studies. More experiments to investigate synergism are in progress and planned.

6) The Philippines (Ms. Julieta A Anarna, University of the Philippines Los Banos(UPLB))

Evaluation of Experiment for Synergistic Effect of Bio N Biofertilizer and Irradiated Oligochitosan

The experiments was conducted aimed to evaluate the synergy effects of nitrogen fixing biofertilizer Bio N and oligochitosan either singly or in combination on the yield of rice and corn.

Bio N™ is a microbial-based fertilizer that contains *Azospirillum* as its major component and soil and charcoal as its carrier. The oligochitosan was sent by Dr. Yokoyama and applied at the concentration of 40ppm applied 3 times 20DAP, 30DAP and 40DAP.

The test plants were rice and corn. The trial under field condition was laid out in a Randomized Complete Block Design (RCBD) with 4 replications and the experimental design used under screen house experiment was a complete randomized block of 4 treatments with 10 replications wherein each pots weigh 8 kilograms of soil. Parameters gathered were biomass, weight of 100 grains and yield per plot.

In 2014, the experiments under screen house condition was conducted for effect of Bio N, Oligochitosan and different levels of chemical fertilizer on the growth and yield of rice.

The treatments used were T1- Control, T2- 100% chemical fertilizer, T3- 50% chemical fertilizer, T4- Oligochitosan + 50% chemical fertilizer, T5- Bio N + Oligochitosan + 50% chemical fertilizer. As a result, T6- Bio N + 50% chemical fertilizer. T5 showed highest increase of dry weight of straw (123%) compared to T1, while T2 showed 81% increase.

The experiments on fresh weight of corn and dry yield of rice as affected by PGP, Biofertilizer and chemical fertilizers were conducted. The treatment used were T1- Control, T2- 100% chemical fertilizers (4 bags UREA(46-0-0)), T3- 50% chemical fertilizer, T4- 50% chemical fertilizers + Oligochitosan, T5- 50% chemical fertilizer + Bio N, T6- 50% chemical fertilizer + Bio N + Oligochitosan. As a result, the combination of 50% chemical + Bio N has increased the yield of both crops 60.75% for corn and 52.31% for rice, respectively, compared to the control. In comparison to the control, the plants applied with combined 50% chemical fertilizer + Bio N + oligochitosan obtained higher yield (corn 59.30% and rice 34.13%). Bio N supplement the 50% nitrogen requirement of the test crop which are shown in different studies conducted in the Philippines.

7) Thailand (Dr Phatchayaphon Meunchang, Department of Agriculture (DOA))

Synergy Effect of Biofertilizer and PGP in Jusmine Rice 105

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.

Ex1. The pot experiment was conducted in sandy soil. The experimental design was in RCBD with 4 replications of 6 treatments consisted of (g of N-P_2O_5-K_2O) T1) 0-0-0, T2) 2-1-2, T3) 1.5-0.75-1.5, T4) 1.5-0.75-1.5+PGPR, T5) 1.5-0.75-1.5+OC, T6) 1.5-0.75-1.5+PGPR+OC. Ex2. 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 (No fertilization). The soil fertility was analyzed for recommend the chemical fertilizer

The result showed that, in the pot experiment on rice variety Jasmine 105, the treatment

application N-P_2O_5-K_2O 1.5-0.75-1.5g+PGPR+oligochitosan did not significant different with the N-P_2O_5-K_2O 2-1-2 g/pot, which might synergy effect of PGPR and oligochitosan. While, in field experiment, effect of PGPR biofertilizer or oligochitosan did also not respond on increase rice yield. But trend of synergic effect of biofertilizer and oligochitosan was observed when fertilization rate was decreased 25%. Filed experiment was related with the result of pot experiment and synergic effect of PGPR and oligochitosan could decrease 25% of chemical fertilizer application rate while PGPR and oligochitosan alone did not show the effect.