Ministry of Education, Culture, Sports, Science and Technology (MEXT)
Forum for Nuclear Cooperation in Asia (FNCA) Biofertilizer Project

FNCA Biofertilizer Newsletter

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Overview of FNCA Biofertilizer Project 2013

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In order to promote environmental friendly sustainable agriculture in Asia, FNCA Biofertilizer Project aims to develop biofertilizers with radiation sterilization technology, using benefical microorgamisms, which increase the yields of crops while reducing the environmental burden of excessive use of chemical fertilizers.

At the first phase of this project from 2001 to 2006, FNCA Biofertilize Manual was published, which gives information and experiences of biofertilizer use in Asian countries, including their effectiveness, efficient production processes, storage and application on different crops, as an important outcome.

At the second phase from 2007 to 2011, main objectives are developing multifunctional biofertilizer having both function of plant growth promoting and resistance against plant pathogens, and dissemination of radiation sterilization method of carrier using ^{60}Co to improve quality of carrier for biofertilizers.

From 2012, new stage of second phase was started to enhance above 2 objectives and it is also focused on synergy effect between biofertilizer and irradiated oligochitosan as a new theme.

FNCA 2013 Workshop on Bifertilizer Project was held on November 18th - 22th in Los Banos, the Philippines with 11 participants from 7 countries.

Participants of the Workshop

In the discussion about activity plans of the project, specific ideas were suggested for the countries where irradiation sterilization has not been implemented in the commercial production of carriers. For example, it was suggested for project leaders to contact biofertilizer producers and do a demonstration to prove the benefits of irradiation sterilization. In the development of multi-functional biofertilizers, the participants agreed on the application of microbiology breeding with irradiation. As for the publication of the FNCA Guideline for Biofertilizer, which is now in the draft stage, members agreed that experts from each member country will make the necessary corrections to the draft, and the first volume (entitled "FNCA Guideline for Biofertilizer Vol.1 Quantification of Beneficial Microbes in Biofertilizer for Quality Assurance and Control") will be published on the FNCA website this fiscal year. The title for the second volume was agreed to be "Production of Biofertilizer Carrier Using Radiation Technology." The draft of Vol. 2 will be prepared next year by experts from Malaysia.

Study for synergistic effect of biofertilizer and irradiated oligochitosan, some positive effect such as plant growth promotor and pathogen suppression, was reported and it was agreed that furhter test will be conducted in conjunction with the FNCA Electron Accelerator Appliation Project.

Visit to Costales Nature Farm

Development of Biofertilizers for Yield Enhancement in China

Fan Bingquan, Chinese Academy of Agricultural Sciences (CAAS)

We have isolated some of phosphate-solubilizing fungus. They showed high capacity to solubilize rock phosphate, $C_3(PO_4)_2$, $FePO_4$, $Zn_3(PO_4)_2$ and $AlPO_4$ (table 1).

And we have done some experiments of phosphate-solubilizing biofertilizer in pot and field conditions. The results showed that phosphate-solubilizing fungi can increase soil available phosphorous concentration and corn biomass/yield (table 2-3). The *Aspergillus niger* C2 showed the highest corn yield than the other fungi.

We have measured the effect of oligochatosan on plant growth. The highest concentration of irradiated oligochitosan at a rate of 100µg/ml can inhibit the growth of *Fusarium oxysporium* on PDA plate, and lower rate had no inhibitory effect (Fig.1). Spray of oligo-chitosan can increase peanut yield by 37.5% over control (table 4).

We studied the effect of multifunctional biofertilizer. The phosphate- solubilizing fungus *Aspergillus niger* C2 increased the corn biomass significantly than that of either nitrogen-fixing *Bacillus* sp. YN29 or silicate-decomposing *Bacillus mucilaginous* in field condition. The corn biomass enhanced 32.15% over control. The combination of *Aspergillus niger* C2, *Bacillus* sp. YN29 and silicate-decomposing *Bacillus mucilaginous* using a high rate of inoculants have got a higher biomass than a lower rate of inoculants(table 5). The results showed that *Aspergillus niger* C2 and a high rate of three strains combination have better effects on the corn growth.

Table 1 Isolation of phosphate-solubilizing strains

Strain	Name	Strain	Name
P250	*Penicilliun variable*	P85	*aspergillus aculeatus*
P41	*Penicilliun variable*	P3-1	*Aspergillus versicolor*
P45	*Penicilliun variable*	P4-1	*Penicillium pinophilum*
P47	*Penicilliun variable*	P103	*Acremonium cellulolyticus*
QH1	*Aspergillus niger*	P93	*Aspergillus niger*
C2	*Aspergillus niger*	P33	*Penicillium verruculosum*
2GW-5	*Talaromyces verruculosus*	P2	*penicillium oxalicum*

Table 2 Corn yield inoculated with P-solubilizing biofertilizers in 2013 (kg/plot)

Strain	Species	shoot biomass	Corn yield	Increase %
CK	No inoculant	3.444	2.156	—
85	*Aspergillus aculeatus*	4.173*	3.015*	39.8
93	*Aspergillus niger*	3.663	2.175	0.9
20851	*Penicillium bilaii*	4.873*	3.090*	42.1
2GW-5	*Talaromyces verruculosus*	4.865*	3.003*	39.3
C2	*Aspergillus niger*	5.778*	3.418*	58.5
P250	*Penicilliun variable*	5.530*	3.153*	46.2
P4	*Penicillium pinophilum*	4.646*	2.970*	37.8
P8	*Penicillium oxalicum*	5.135*	3.085*	43.1

Table 3 Corn biomass and soil available P_2O_5 inoculated with P-solubilizing biofertilizers under rock phosphate application (g/pot)

No	shoot biomass (g)	Increase %	Avail- P2O5	Increase %
CK	3.32	-	4.78	-
36	4.31	29.8	6.73	40.8
43	4.02	21.1	6.95	45.4
83	4.01	20.8	6.61	38.3
Significant	0.01	-	0.01	-

Table 4 Peanut yield applied with oligo-chitosan (kg/plot)

Replicate	CK		Spray 10ml 2 time		Spray 20ml 2 time		Spray 30ml 2 time	
	Fresh wt	Shoot wt	Fresh wt	Shoot wt	Fresh wt	Shoot wt	Fresh wt	Shoot wt
1	0.55	0.7	0.45	0.75	0.65	0.85	0.6	1.25
2	0.35	0.7	0.55	1.05	0.65	1.05	0.55	0.65
3	0.49	0.75	0.75	0.9	0.5	0.85	0.8	1.3
4	-	-	0.5	1.0	0.4	0.7	0.6	0.75
Mean yield	0.46	0.72	0.56	0.93	0.55	0.86	0.64	0.99

Fig.1 Effect of oligo-chitosan on growth of *Fusarium oxysporium*

Fig.2 Effect of oligo-chitosan on growth of peanut

Table 5. Corn biomass inoculated with multifunctional biofertilizers in field

No	Treatment	Fresh Wt (kg)	Increase %	Dry Wt (kg)	Increase %
1	CK	1.790	-	0.316	-
2	*Bacillus* sp. YN29	2.500	39.67*	0.412	30.50*
3	*Aspergilus niger* C2	2.673	49.35*	0.418	32.15*
4	Bacillus mucilaginous	2.100	17.32*	0.326	3.19
5	2+3+4（low rate）	1.873	4.65	0.283	-10.32
6	2+3+4（high rate）	2.120	18.43*	0.372	17.78*
Significant		<0.01		<0.01	

A Way forward on Promotion and Commercialization of Biofertilizer in Malaysia

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Food production, food security and global warming are the current issues around the world. All these issues are related to agriculture production. A major factor in agriculture production is fertilizer application. According to Food and Agriculture Organization of the United Nations (FAO), 2012, world fertilizer nutrient ($N+P_2O_5+K_2O$) consumption is estimated to reach 180.1 million tonnes in 2012, up by 1.9 percent over 2011. World demand for total fertilizer nutrients is estimated to grow at 1.9 percent per annum from 2012 to 2016. There are high demands of fertilizer in Malaysia such as in the production of oil palm, rubber, cocoa, rice, pineapple, banana, vegetables and ornamentals. Demands on fertilizer are not only focussed on chemical fertilizers but also organic, bioorganic fertilizers and biofertilizers. In conjunction with the high demands, research and production of bioorganic, organic fertilizers and biofertilizers are on the increase in Malaysia.

In Malaysia, research on biofertilizer microorganisms had started since late 1980s and early 1990s on arbuscular mycorrhiza fungi (AMF) and nitrogen fixing bacteria. In the early 1990s nuclear technique using isotopic tracers was employed in biofertilizer R&D. Biofertilizer development project at Malaysian Nuclear Agency (Nuclear Malaysia) started in 2002. This project focused on free-living N_2 fixing bacteria, arbuscular mycorrhizal fungi, phosphate solubilising microbes and plant growth promoting rhizobacteria (PGPR) in biofertilizer development.

Nuclear Malaysia received two ScienceFund grants from the Ministry of Science, Technology and Innovation (MOSTI) for biofertilizer projects in 2007 and 2011 for research and development of biofertilizer products. Nuclear Malaysia has developed a series of multifunctional bioorganic fertilizers from these grants, which include two multifunctional bioorganic fertilizers namely, MULTIFUNCTIONAL BIOFERT PG & PA and a pellet bioorganic fertilizer as MF-BIOPELLET, in an effort to reduce dependency on chemical fertilizer for crop production. Acceptance of biofertilizer by agroindustry especially oil palm and rubber plantation has increased over the years. In 2009, Malaysian Agri Hi-Tech Sdn. Bhd. (MYAGRI), the bioproducts company with BioNexus status, utilising *Bacillus megaterium*, a biofertilizer inoculum generated through R&D of Nuclear Malaysia in one of its products, agriCare®ORGANIC-N. In 2011.the company produced about 40 t of agriCare®ORGANIC-N. To date, more than 191t has been produced, with worth of RM 630,000 in sales. On 28 August 2013, the Minister of MOSTI launched a liquid biofertilizer (BIOLIQUIFERT) produced by Nuclear Malaysia as one of the products generated through the government ScienceFund grants. This is an effort of government to commercialise R&D products, and this could be capitalised to promote the use of biofertilizer to our agroindustry.

Nuclear Malaysia has also undertaken the initiative to promote and commercialise biofertilizer products through various of exhibitions such as Innovation Day of Nuclear Malaysia at Nuclear Malaysia; Creativity Carnival and Science 4U, SMK Tun Haji Abdul Malek, Cheng, Melaka; JB Asean International Trade Expo & Business Forum 2013, Johor Bahru, I-Inova 2013, USIM at Nilai and National Innovation Conference and Exhibition (NICE) 2013 at Kuala Lumpur Convention Centre. Through these exhibitions, nuclear technology in biofertilizer development is also promoted, to produce quality products.

MOSTI plans to make 2014 as "Commercialisation Year", with that there will be more effort of commercialisation will be done. Furthermore, there are two types of grants are offered by MOSTI to support commercialisation R&D products. They are TechnoFund and InnoFund. TechnoFund is a grant scheme which aims to stimulate the growth and successful innovation of Malaysian enterprises by increasing the level of R&D and its commercialisation. The scheme provides funding for technology development, up to pre-commercialisation stage, with the commercial potential to create new businesses and generate economic wealth for the nation. InnoFund is a grant scheme which funds the development or improvement of new or existing products, processes or services with elements of innovation. The project must have economic value and improves the societal well-being of the community. InnoFund can be categorised into Enterprise InnoFund (EIF) and Community InnoFund (CIF). With all the supports from government, there is a way for biofertilizer industry to grow along with modern agriculture, leading to quality agriculture produce and taking care of the wellbeing of the people and the environment.

Bioorganic fertilizer and biofertilizer produced by Nuclear Malaysia

Bioorganic fertilizer produced by Nuclear Malaysia and MYAGRI

Launching of MOSTI Commercialisation Year 2014 (MCY 2014) by MOSTI Minister on 23 January 2014

FNCA Biofertilizer Research Activity in 2013, Mongolia

Delgermaa Bongosuren, Plant Science Agricultural Research Institute (PSARI)

Progress of project activity

In 2013 we conducted including: 1) Effect of rhizobacteria inoculation to wheat crops, 2) Strategy for extension of bio fertilizer to farmers to enhance sustainable agriculture 3) Experimental results on synergy between bio fertilizer and irradiated oligochitosan.

We have developed multi-functional Biofertilizer, they are N-fixing Azospirillium and Azotobacter, P-solubilizing Azoarcus sp microbial strains. Produced their mixed strains under the trade name of Rhizobacterial biofertilizer. Have been studied field experiment on wheat crop. Application of soil nutrition uptake increased nitrate by 0.6-3.35 mg/kg, phosphate by 0.32-0.42mg /100 g, humus content by 0.13-0.18%. Bioferilizer produced by using beneficial microorganisms have a positive economic impact in terms of nitrogen fertilizer saving and increasing the crop yield. 6 tons of biofertilizer is produced and distributed to farmers in this year. The field trial and demonstration showed, that biofertilizer are able to increase crop yield from 10- 25%, save 15-20% of required chemical N and P fertilizers.

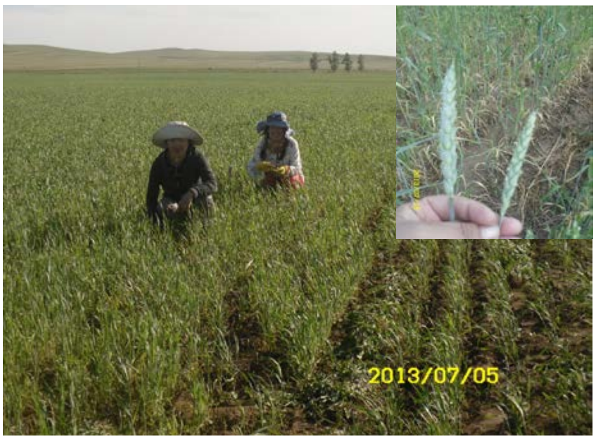
Experiment on synergy effect of biofertilizer and oligochitosan

In 2013 we conducted experiments "Study on plant pathogen suppression tomatoes".

The experiment of a multistrain Biofertilizer/BF/ containing *Azospirillum*, *Azotobacter* and *Azoarcus* with 100 ppm of oligochitosan applied to leaves at every week and 2 weeks of tomato yield under a Fusarium contaminated soil on growth of tomato are tested in the green house. It showed that oligochitosan and biofertilizer have the synergy effect on growth and yield of tomato.

Table: Fruit yield of tomato

Treatments	Yield		
	Average weight of per fruit, g	Number of fruit per plant	Yield from per plant, kg
Control	69.2	10	0.675
Oligochitosan every week	55.6	13	0.735
Oligochitosan every 2 weeks	54.9	16	0.839
BF + Oligochitosan every week	75.7	13	0.968
BF + Oligochitosan every 2 weeks	74.7	16	1.169



Field Experiment

Green House Experiment

Current Research and Improvement of *Bio N*^{TM} Biofertilizer for Sustainable Production of Agricultural Crops in the Philippines

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Introduction

The Philippine government had emphasized and promotes the concept of bio-organic farming to help farmers reduce expenses by decreasing their dependence on chemical fertilizers.In organic farming chemical fertilizers and use of herbicides are not allowed in organic production so the farmers have to search for the best alternative organic practices that can substitute nutrients for optimum plant growth and yield. There are already emerging and proven biotechnologies that can be utilized in rice, root crops, and high value crops which have been shown to reduce and/or complement the use of the expensive inorganic fertilizer inputs. Bioorganic fertilizers (BOF) is a processed inoculated compost from any organic material that has undergone rapid decomposition by the introduction of homogenous microbial inoculants. On the other hand biofertilizers are compounds that enrich the nutrient quality of soil by the use of microorganisms having symbiotic relationship with the plants. The use of bioorganic and biofertilizers have been advocated but this have never been documented scientifically. The effect of the bio-organo-way of fertilization has not been used by many farmers and never been fully documented. The potential of this combination, if coupled with inoculation with appropriate nitrogen fixing microorganisms (Bio N) and mycorhiza (Mykovam) assumed to furnish the most complete array of elements needed by crops. This experiment is intended to develop a package of technology that will encourage farmers to practice organic farming that will give yield and income comparable to conventional farming. Secondly, that will improve environmental condition, health of the people and affordable price of the organic products that both the rich and poor can afford.

A source of biologically fixed nitrogen through the associative system has been developed at the National Institute of Molecular Biology and Biotechnology (BIOTECH), UPLB with a brand name ***Bio N***. ***Bio N*** is a microbial-based fertilizer that was isolated from the roots of Talahib (*Saccharum spontaneum L.)* and contains *Azospirillum* as its major component with soil and charcoal as its carrier.

This product which comes in powder form in a 200 gram packet is environmentally safe and is meant for seed inoculation, direct broadcasting, or can be used as a root dip when mixed with water. This is also capable of supplying 50% of the nitrogen requirement of rice, corn and now tested for vegetables.

The use of microorganism to harness elemental nitrogen through nitrogen fixation is one of the promising technologies. This technology encourages the use of beneficial microorganism in improving growth and yield of rice, corn, sugar cane and high value crops. It could support the economy of the country since dependency on inorganic fertilizer will be reduced.

Evaluation of the Performance of *Bio N* and Mykovam on the Yield of Tomato and Eggplant in the Philippines, DS 2013

Tomato: An experiment for tomato was conducted in Tayabas, Quezon to determine the effect of integration of biofertilizers (Bio N and Mykovam) and bioorganic fertilizer (vermicompost) and compare with the treatments using chemical fertilizer (Fig. 3). The highest yield was 14 kg gathered in 10 plants that was fully fertilized by nitrogen fertilizers, followed by ½ recommended rate of nitrogen fertilizers rate in the presence of Bio N (T2-11.40 kg) while yield gathered from the combined biofertilizers and vemicompost was 11.50kg. The lowest yield was 6kg in T 4 (Bio N + Mykovam*).* This field data revealed that with ***Bio N*** inoculation, the dependence or application of nitrogen with this variety was reduced and the yield obtained from the combination of biofertilizers and bioorganic fertilizers was not significantly different from the yield of treatment applied with full chemical fertilizer. In this initial study it may be concluded that the application of bioorganic fertilizers increased the activity of biofertilizers as it was revealed with T4(Bio N + Mykovam) with lowest yield obtained.




Table1. Effect of combined biofertilizer and chemical fertilizer on yield of tomato (Avatar), Tayabas, Quezon, DS 2013

Treatment	Yield (kg) / 10 plants
T1 - Full recommended rate of chemical fertilizer	**14 A**
T2 - ½ Recommended rate of chemical fertilizer + ***Bio N***	11.40 A
T3 – ***Bio N*** + Mykovam + Vermicompost	11.50 A
T4- ***Bio N*** + Mykovam	6.075 B
C.V 19.92%	



Bio N **™**

From the roots of "talahib" grass (*Saccharum spontaneum* L.) several nitrogen-fixing bacteria were isolated which were found capable of enhancing shoot growth, root density and yield of rice corn and sugar cane. The bacteria were found to possess at least 57% of the characteristics of the genus *Azospirillum*. Several reports from field tests in different regions of the country confirmed the significant contribution of these nitrogen-fixing bacteria to yield improvement of corn, rice and few vegetable species. These associative nitrogen fixing bacteria were found to be capable of producing growth regulators like gibberellins and cytokinins, which were thought to contribute to stimulated plant growth.

The use of Bio-N inoculants have been demonstrated to complement some 30-50% of the total nitrogen needed for rice and corn, hence the input of chemical N fertilizer is minimized or reduced. Consequently, the natural soil microflora and the original soil properties are maintained.

Mykovam

Experimental Design and Treatment

Two separate experiments were sequentially set up at the farmers level in Cavinti, Laguna. The study was laid in Randomized Complete Block Design (RCBD) with four replications. **Each plot measured 5 m x 3 m, with a total of 15 m^{2}. The whole plot were planted with 15 plants with a distance of between hills and furrows** while the borders for each block was 0.5 m.

The field layout of the experiment is shown in Figure 1, where the main plot (A) levels were:

For eggplant the tretaments used were:

- T1 – Farmers Practice (Chicken manure 1/2kg per hill)
- T2 – Bio N + chicken manure
- T3 – Bio N + Vermicompost (Kits vermi) + Farmers Practice
- T4 – Bio N + Mykovam + Farmers Practice
- T5 – Bio N + Mykovam + vermicompost + Farmers Practice

Bio N was applied by watering the plants at the rate of 20 packets per hectare (plant density of 33,333) before transplanting while Mykovam was applied during transplanting at the rate of 5 grams per hill. Bioorganic fertilizers used in the experiment were commercial grade and applied at the rate of ½ kg per hill. Fertilization recommendation used was the Institute of Plant Breeding protocol consisted of a basal application of 10 grams/hill of complete fertilizer (14-14-14). Ten days later and 2 weeks thereafter, 1 tbsp of a combination of 2 parts Urea (46-0-0) and 1 part muriate of potash was applied as side dress to each plant. Yield data were gathered every harvest from the central 10 plants of the plot (Fig2.).

Trend of Multifunctional of Rhizobium in Promote Rice Growth

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Multifunctional of soil microbe was reported for several decades. Formerly, biofertilizer was accepted for the interaction of rhizobium within nitrogen fixer of leguminous crop. At present, the meaning of biofertilizer are extended to other microbes function such as free living nitrogen fixing, phosphate solubilizing, potassium solubilizing and IAA producing microbes. Diverse genera and species of microbes were reported that functional as biofertilizer.

The multifunctional of some genera have been reporting, especially in rhizobium group. Utilize rhizobium as inoculants of legumes its functional as nitrogen fixer. Utilize rhizobium as inoculants within non-leguminous plants, which multifunctional as the plant growth promoting rhizobacteria. The rhizobium was able to produce IAA, solubilizing phosphate and potassium and other multi-mode of functions. In Thailand in 2013, conducted experiment in pot to search the possibility of use rhizobium alone and co-inoculation with Azospirillum in different nitrogen rates. The purpose of this experiment had searched the effect of rhizobium on shoot and root dry weight of rice, when inoculated single and co-inoculated with *Azospirillum*.

The result showed that shoot and root dry weights of rice respond very good on treatment inoculated with rhizobium (fig.1 a. and b.) especially in highest N application treatment, indicated that rhizobium had functional not only fixed nitrogen in legume crops but also promoted rice growth by increasing root weight (fig.1 b). The result had also indicated that co-inoculated of rhizobium and Azospirillum was better than inoculated with rhizobium or Azospirillum alone. Even their mechanism did not yet clear.

However, the result suggested that multi-functional of rhizobium both nitrogen fixing biofertilizer of legume and plant growth promoting biofertilizer of rice has been interesting alternative multifunctional biofertilizer from FNCA project.

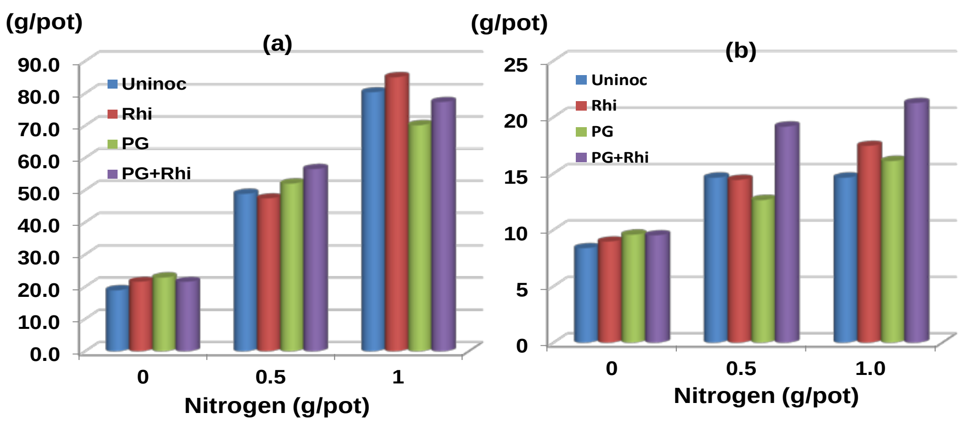

Fig 1 Effect of co-inoculants of *Azospirillum* and *Bradyrhizobium* in different nitrogen rates on shoot dry weight (a) and root dry weight (b) of rice

Multifunctional Biofertilizer Research and Development in 2013

Pham Van Toan, Ministry of Agriculture and Rural Development (MARD)

1. Introduction

Sandy soil is poor in organic matter, nutrition elements and have low moisture. Agricultural production in sandy soil is difficult and unstable. Solution for agricultural production in sandy soil should be the selection drought tolerance crops, improving the irrigation system and the soil fertilities through the increasing the organic matter, the soil moisture and the soil nutritions. Biofertilizer will improve the agricultural production in sandy soil.

2. Material and methods

Biofertilizer for sandy soil contained N-fixer *Bradyrhizobium japonicum*, P-solubilizer *Bacillus megaterium*, Cilicate solubilizer *Paenibacillus castaneae* and polysaccharid producer *Lipomyces starkeyi* with the density of more than 10^8 CFU/gram. Trials were conducted in Binhdinh province with following treatments: 1. cashew fertilized by farmer practice, 2. cashew fertilized with biofertilizer and 3. cashew intercropping with peanut fertilized with biofertilizer.

3. Results

3.1. Effect of biofertilizer on agricultural production in sandy soil

The results of effect of multi-functional biofertilizer on growth, yield of peanut and cashew in sandy soil of Binhdinh province showed that biofertilizer can increase the growth and yield of tested crops and also improve the fertility of sandy soil. Intercropping system of cashew and peanut applied multi-functional Biofertilizer improved the sandy soil fertility as well as increased the yield of cashew 23% and bring for farmers the profit of more than 10 millions VND/ha in comparison to the control (table 1, 2).

3.2. Experiments of synergy effect between biofertilizer and irradiated oligochitosan

Irradiated oligochitosan from Japan and research & develoment center for radiation technology (Hochiminh City) is added to broth medium for P-solubilizer Bacillus and tomato root pathogen R. *solanacearum* with concentration of 50, 100, 150 and 200 ppm. The effect of oligochitosan on growth of tested microbes is evaluated by plate count method. The results showed no effect of oligochitosan on growth of Bacillus in all concentration of 50, 100, 150 and 200 ppm. The concentration of 200 ppm oligochitosan inhibited the growth of R. *solanacearum*. Synergy effect of oligochitosan and biofertilizer on growth of tomato are tested in the field of Hanoi. It showed, that oligochitosan and biofertilizer have the synergy effect on growth of tomato. The effect of disease control will be better when oligochitosan applied to the soil before transplanting. The combination of oligochitosan soil treatment and spraying in every 7 days had the disease control effect of more than 68%.

Table 1. The economical effects of biofertilizer on intercropping the cashew with peanut

Parameters		Control	Biofertilizer
Total input (1.000 VND)	Cashew	10.226	10.226
	peanut	-	28.665
Yield (tons/ha)	Cashew	0,78	0,97
	peanut	-	1,55
Total outcome (1.000 VND)		19.500	58.350
Benefit (1.000 VND)		9.274	19.459
Benefit to control (1.000 VND)		-	10.185

Table 2. Effect of biofertilizer on the nutrition of sandy soil intercropped cashew and peanut

Parameter	Control	Biofertilizer
Moisture (%)	4,40	5,86
Organic Carbon (%)	0,22	0,28
Total N (%)	0,05	0,06
Total P_2O_5 (%)	0,01	0,02
Total K_2O (%)	0,02	0,02
Avail. P_2O_5(mg/100 g)	1,43	4,57
Avail. K_2O (mg/100 g)	2,41	3,62

Cashew without biofertilizer

Cashew with biofertilizer

Cashew intercropping with peanut applying biofertilizer