Annex 5. Parallel Session Summary on Biofertilizer Project

Parallel Session Summary on Biofertilizer Project

Session 1　Country Report

Nine countries reported research progress for 2017. Summaries of their reports are as follows.

1) Bangladesh (Dr. Md Kamruzzaman Pramanik, BAEC)

Off late, Bangladesh government has given emphasis on eco-friendly agricultural practice and application of biofertilizer in lieu of chemical fertilizer is very promising in this regard. Several symbiotic and associative microorganisms have been isolated from different sources and some of which showed multifunctional fertilizing characteristics. Synergistic effect has been sought on rice and soybean plant using those biofertilizer along with irradiated oligo-chitosan. Moreover, sterilization of carrier material using gamma-irradiation seems to be fruitful for producing quality biofertilizer.

2) China (Dr. Zhang Ruifu, CAAS)

1. We developed multifunctional biofertilizer production for plant growth promotion and soil disease suppression;
2. Our greenhouse experiments showed that irradiated oligo-chitosan and biofertilzier have positive synergistic effect for plant growth promotion;
3. ^{60}Co γ-ray irradiation is better than autoclaving for biofertilizer carrier sterilization for avoiding contamination and storage of biofertilizer.

3) Indonesia (Prof. Iswandi Anas, IPB)

Study on multifunctional of microbial strains able to solubilize phosphate and potassium has been carried out. Through FNCA collaborative reseacrh in 2017, beneficial characteristics had been improved through mutation of these selected bacteria and fungi by using gamma irradiation. We were able to obtain bacterial mutant and fungus mutant which have stronger ability to solubilize phosphate and potassium. In the future we will evaluate the stability of mutants ability to solubilize phosphate and potassium. Then we will evaluate the effect for innoculation of these mutants on growth of some crops. Positive synergetic effect between biofertilizer and oligochitosan on chili as well on pepper had been shown also.

4) Japan (Dr. Shotaro Ando, JIRCAS)

To develop multifunctional *Bacillus* biofertilizer, plant growth promotion effect of paddy rice and suppressive effect of rice blast were evaluated. PCR method to count the number of inoculated strain was developed. Microbial mutation breeding using ion beam was conducted to develop 1) salt tolerant rhizobia, 2) enthmopathogenic fungi with tolerant to fungicide, and 3) Cs-accumulating bacteria.

5) Kazakhstan (Ms. Olga Timofeyeva, "Promishlenoe snabzhenie" LLC)

Activity in 2016

For the first part, SWA and PGP was applyed on barley, crown flax and wheat. Result is satisfactory.

Activity in 2017

The experiment in 2017 with PGP on the north of Kazakhstan on the area of 2000 hectares on hard wheat, legume plants and barley (50 ppm) did not bring expected results.

The experiment in Almaty region with PGP (50 ppm) on corn showed satisfactory results.

The experiments are being carried out to find out whether oligo chitosan is an oppressor of bacteria.

Plans

- The study of radiation breeding (radiation mutation)
- Determination doses for bacteria breeding
- Study of synergy combined effect by applying BF+SWA+PGP
- Publication of experiment results

6) Malaysia (Ms. Rosnani Binti Abdul Rashid, Nuclear Malaysia)

Malaysia reported on commercialization activities and strategies for extension of biofertilizer products to end users via technology transfer, discussed some progress in the investigation on synergy between biofertilizer and plant growth promoter (irradiated oligochitosan) in chili, okra and banana. In addition, advances in radiation mutagenesis study to generate multifunctional biofertilizer organisms included evaluated of these mutants in greenhouse trial.

7) Mongolia (Dr. Delgermaa Bongosuren, IPAS)

The biofertilizer project in Mongolia is continuous work and multi-functional Biofertilizer were developed. In 2001, the institute successfully produced dry type of rhizobacterial biofertilizer, in 2017, liquid type of rhizobacterial biofertilizer as well as increasing mass production. 20 tons of liquid and 5 tons of dry type biofertilizers were 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% and save 15-20% of required chemical N and P fertilizers.

8) The Philippines (Ms. Julieta Anarna, UPLB)

One of the microbial inoculants produced at BIOTECH, University of the Philippines Los Baños is a nitrogen fixing biofertilizer (*Azospirillum*) with a brand name *Bio N™*. Application of *Bio N™* has been extensively applied and used in different varieties of rice and corn at different regions of the Philippines and now being tested for high value crops of the country especially for tomato, eggplant and sugarcane. Combined inoculation of biofertilizers and oligochitosan were tested on rice, corn while the integration of two biofertilizers (Bio N and Mykovam) were tested for tomato. Results of the studies showed that the combined application of biofertilizers and oligochitosan and the integration of two biofertilizers have higher yield compared to control (unfertilized, uninoculated) treatments. Massive information campaign were conducted for the

awareness of the farmers on the benefits of biofetilizer, proper utilization of the technology, and improve marketing.

Soil and charcoal are used as the carrier in Bio N production and sterilized by using heat autoclave technique. From several studies conducted under the FNCA project and collaboration with the Philippine Nuclear Research Institute (PNRI) using nuclear technique sterilization the production of carrier was improved and lifespan of the Bio N inoculant was prolonged from six months now it is 10 months. .

9) Thailand (Dr. Phatchayaphon Meunchang, DOA)

Thailand produced biofertilizer more than 35 years. At present, it is still popular for farmers. The biofertilizers have been already produced and extended to farmers as rhizobium, PGPR, Phosphate solubilizer and Mycorrhiza.

Thailand succeeded on research for use of carrier sterilization by gamma ray and electron beam at 25 kGy to produce PGPR biofertilizer for rice, which Azospirillum and Burkholderia survive over Thai law standard longer than 6 months. But it could not be used in production system due to high cost in the step of radiation sterilization.

The synergistic effect of PGPR bifertilizer and oligochitosan was showed in pot experiment but it was not clear for in field experiment.

Session 2 Special Lecture

Prof. Gary Stacey, Super Professor, Tokyo University of Agriculture and technology delivered special lecture titiled “Mechanistic studies of bacterial plant growth promotion utilizing model plant species”. Summary of the presentation is as follows.

Plants interact with a wide range of soil microorganisms. In some cases, this interaction can result in significant benefits to both microbe and plant host. It is well known that some soil bacteria can promote the growth of plants increasing crop yield. The effects of such ’plant growth promoting bacteria’ (PGPB) have been well documented with a variety of plant species. One lesson from such studies is that both the bacterial and plant genotype are critical in order to induce significant growth promotion. However, the molecular mechanisms behind this growth promotion are still largely unclear. We believe that the adoption of a suitable model bacterial-plant system could significantly accelerate research to increase our mechanistic understanding of these important associations. The ultimate goal would be to exploit this information to increase the adoption and benefits of PGPB in crop production.

Session 3 Development of Multifunctional Biofertilizer and Strategy for Extension to Farmers

The FNCA member countries presented the extension of multifunctional biofertilizer in each country. Indonesia isolated some microbial strains and carried out mutation by gamma irradiation. It was found that a bacterial mutant increased both phosphate and potassium solubilization and one fungal mutant increased solubilizing ability of phosphate. The Philippines produced Bio-N (*Azospirillum*) for rice and maize and conducted experiment of

tomato with mycorrhiza. Thailand confirmed the multifunctional activity through coinoculation of *Azospirillum* and *Bradyrhizobium*, and showed that in the 10^4 cfu per ml of both genus increased nitrogen fixation. China developed multifunctional biofertilizers for root development and soil borne disease of several cash crops. Malaysia isolated microbial mutant from gamma irradiation and now in stages to evaluate on greenhouse trial. Bangladesh isolated two bacterial strains which are capable of fixing atmospheric nitrogen and solubilizing phosphate. Mongolia tested a liquid biofertilizer (*Azospirillum* + *Azotobacter* + *Azoarcus*) for wheat. Kazakhstan will develop multifunctional biofertilizer near future.
All member countries have extended biofertilizer to the farmers/endusers.

Session 4 Summary of Experiment for Synergistic Effect of Biofertilizer and Irradiated Oligochitosan, Plant Growth Promoter

Bangladesh, Japan and Thailand found synergistic effect of biofertilizer and irradiated oligochitosan on rice, tomato and rice, respectively. Other countries found some positive effect on different crops.

Session 5 Extension of Radiation Sterilization of Carrier for Commercial Biofertilizer Production

Reports from member of the FNCA countries namely Indonesia and Malaysia, they have private companies using gamma irradiation sterilization in the production of biofertilizer. In case of the Philippines gamma irradiation technology is being applied in large scale production. Bangladesh and Thailand also use sterilized carrier material by gamma ray for biofertilizer in small scale. It was also reported some limitations on the use of the facility such as distance and availability of the facility.

Session 6 Development of Publication for Compared Effect of Radiation Sterilization and Autoclave

For sterilization of biofertilizer carriers, gamma irradiation gave better results compared to autoclaving. The gamma irradiation sterilization of carrier was found more effective for the maintenance of inoculant microbes during long-term. China, Indonesia, Japan and Malaysia have already published paper on this issue. These findings will be published in The Philippines. Thailand has submitted for a patent.

Session 7 Development of FNCA Guideline for Biofertilizer Quality Assurance and Control

The compilation articles of "FNCA guideline Volume II: Production of Biofertilizer Carrier Using Radiation" was discussed. The additional information by all country members will be added in this guideline. It will be published in March 2018.

Session 8 Activity Summary, Evaluation, and Future prospects

Achievements in phase 4 were evaluated and it was confirmed that research plans were successfully accomplished. 1) Development and dissemination of radiation sterilization method

of new types of carrier, 2) development of the multifunctional biofertilizer with emphasis on the radiation breeding of microbes, and 3) evaluation of integrated effect of biofertilizer and irradiated oligochitosan, carageenan and super water absorbent (SWA) were proposed as future themes.

Session 9　Summary of Parallel session for Biofertilizer Project

The summary of parallel session on Biofertilizer Project was discussed and agreed by all participants.