Annex 4

Research Activity of RPPM project in 2018-21

Research subjects	Bgd	Chn	Idn	Kaz	Jpn	Mys	Mng	Phl	Tha	Vnm
1. Degraded Chitosan for Animal Feed			✓			✓				✓
2. Hydrogel for Medical Application	✓				✓	✓	✓	✓		✓
3. Environmental Remediation		✓				✓	✓			✓
4. Synergistic Effect among PGP, SWA and BF	✓		✓	✓		✓	✓	✓		
5. PGP and SWA, inclusive Process development	✓		✓			✓		✓	✓	
6. Mutation Breeding of BF Microbe using radiation		✓	✓			✓				✓
7. Sterilization of BF Carrier using radiation			✓			✓	✓		✓	✓

Wrap-up of presentations for 2018-2021 BF

Bangladesh	A semi-field level experiment was carried out to study combined effect of irradiated chitosan as PGP and Azospirillum species as biofertilizer on rice plant with six different treatments. Grain yield of rice (t/ha) increased up to 1.77% and 4.45%. To screen potential nitrogen fixing symbiotic bacteria for soybean, bacteria were isolated from root nodule of Glycine max which can be used as biofertilizer in combination with PGP like oligo-chitosan. Twenty Isolates were classified into 9 different groups. Isolates were identified up to 99.72% similarity upon BLAST analysis.
China	Screened three high efficient phosphate solubilizing microorganisms (PSB) strains, valued in pot experiments, applied in winter wheat in field. Irradiation breeding of a biofertilizer strain of Trichoderma guizhouenase NJAU4742 by X-rays to get improved mutants for stress tolerance, plant growth promotion and fungal pathogens suppression, obtained the mutation sites by resequencing the mutants and cloned the acid-resistant gene.
Indonesia	The mutants of BPK5 and FPF4 obtained by radiation have the highest ability to solubilize phosphate and potassium in liquid medium. The synergistic effect of using oligochitosan biocontrol and biological fertilizers clearly has a positive synergistic effect for NH4+ accumulation and phosphate solubilization.
Kazakhstan	--
Japan	--
Malaysia	Malaysia successfully commercialized Bioliquifert, GoGrow BioNPK , Migrofas M99 and Bioliquifert M100 that developed by using nuclear technology such as N-15 isotopic tracer technique. A total of 770,000 L Bioliquifert were distributed to paddy growers in West Malaysia from year 2020 to 2021. Total sales were RM 13,090,000. Synergic effects of oligochitosan with biofertilizer were positive for chili and maize but negative for rice and strawberries. Gamma irradiation had been use for mutagenesis BF microbe and carrier sterilization. Toxicity test had been done. Seed treatment and bioremediation are in progress.
Mongolia	Rhizobium and Rhizobacterial fertilizer were produced by radiation technique. Rhizobium bio-fertilizer increases the crop yield and the number of Rhizobium nodules on crop roots by 2 times. The liquid Rhizobacteria fertilizer increases yield of wheat grain, seed potato yield and yield of vegetable crops /carrot, onion, tomato, sweet pepper etc.

Wrap-up of presentations for 2018-2021 BF

the Philippines	The institute has produced wide arrays of microbial inoculant products from Azospirillium, Mycorrhiza, Rhizobium, PGPR and Trichoderma species. The combined application of biofertilizers, PGP, and carrageenan will supply nutrient requirements of plants for sustaining desired crop productivity. The interaction effect tests among BIOTECH different commercially and proven technologies were conducted to determine the effect of mixed inoculation as compared with chemical fertilizer using corn, tomato and eggplant as the test crops. Economic analysis among treatments was also recorded. Sterilization of Bio N carrier through gamma irradiation at 20 kGy enhanced life span and improved production.
Thailand	Plant growth promoting bacteria were isolated and classified into 2 genera. Department of Agriculture starts transferring the biofertilizer technology to private company and can transfer all 3 types of the biofertilizer production technology to 5 private companies and currently have 3 companies registered for commercial biofertilizers for rice. The contaminated sterilization method was carried out by studying the survival of bacteria used in the PGPR-I production: Azospirillum brasilense TS13 and Beijerinckia mobilis TB5 can survive in all types of carriers (1) Non-sterilized 2) autoclaving sterilization at 110oC for 30 minutes; 3) autoclaving sterilization at 121oC for 30 minutes; 4) sterilization by γ-irradiation at 25 kGy; and 5) sterilization by γ-irradiation at 45 kGy). Azospirillum brasilense TS13 had the best survived in carrier type 4 and Beijerinckia mobilis TB5 had the best survived in carrier type 1. Otherwise, Azotobacter vinelandii AT125 cannot survive in carrier type 4 and 5.
Viet Nam	BF (Rapol-V) based on radiation modified starch as main component of carrier much increased the crop yield, and also reduce at least 20% NPK without any negative impacts to the yield and quality of vegetable. Screening the high cellulase producing Trichoderma mutants for preparation the rice straw degradation products.

Wrap-up of presentations for 2018-2021 PM

Bangladesh	Foliar application of oligo-chitosan increase the growth and yield of crops, fruits and vegetables over control . The oligo-chitosan also shows the ability to shorten the harvest time in contrast to control and it can also display antibiotic activity against microorganisms including bacteria and fungi on tomato and egg-plants. Physicians in hospital are successfully applying the radiation crosslinked hydrogel samples as an external use to the burn and wound patients and gave a certificate. I) Incorporation of Antimicrobial Activity in PVA-hydrogel by adding Chitosan and their antimicrobial quality improvement by gamma radiation. II) Synthesis of Silver-Chitosan Nanocomposite as antimicrobials
China	Waste water treatment using EB irradiation entered the stage of large-scale commercial application with a daily wastewater treatment capacity of 30,000 tons. Several types of novel fibrous adsorbents were synthesized and more than 100 g uranium was extracted from seawater. Many companies cooperated for adsorption materials production on pilot scale. Super Water Adsorbent were prepared with radiation technology and used for desertification control in west China. Novel Coronavirus irradiation inactivation test move to pilot stage, radiation technology is expected to be used in cold chain Novel Coronavirus eradication.
Indonesia	The application of oligochitosan as for PGP was conducted in pepper and chrysanthemum plant. As a result, oligochitosan increased the pepper plant and made shorter harvesting time on the chrysanthemum. The administration of oligochitosan was able to increase nutrient digestibility and metabolic energy of Indonesian poultry and local hen variety namely Sentul hen. The same tendency was also observed for increasing body gain in Indonesian local variety cow namely Pasundan cow.
Kazakhstan	Over three years of observations in the nursery "Semei Ormany" farm, effectiveness of SWA produced by irradiation was confirmed. The "BetaSorb" trademark is registered and entered in the State Register of Trademarks. Patent for the invention "Method of synthesis of polymeric hydrogel for agricultural crops" was received. Industrial production of SWA is well established and a subsidiary enterprise "BetaSorb" LLP was established.
Japan	Functional hydrogels of gelatin for bio- and medical-applications were prepared by using the radiation crosslinking technique. The obtained hydrogels were applied to three-dimensional cell culture substrates that can control the arrangement of muscle fibers, and to nanoparticle-type MRI contrast agents that are rapidly discharged from the body without accumulating in the brain.

Wrap-up of presentations for 2018-2021 PM

Malaysia	Chitosan, carrageenan, and sago waste are natural resources-derived polymers utilized in our RPPM project for development of hydrogel for medical application, PGP, animal feed supplement and absorbent for agriculture. The polymers are treated with gamma radiation to induce whether degradation, crosslink, sterilization, or combination of these reactions depending on the process requirement and product designs. Radiation implies various modification of polymer chains and networks to fulfill and expand the product characteristics.
Mongolia	PVA based hydrogel is prepared by cryopolymerization (freeze-thaw) method and mixed with ZnO, Ag2O nanoparticles. Up to 60nm nanoparticles were effective against pathogenic bacteria (MRSA) in disk diffusion method. However, pore size analysis and biodegradability of PVA Hydrogel is not tested yet.
the Philippines	Radiation-crosslinked hydrogels based on carboxymethyl cellulose and k-carrageenan/polyethylene oxide were prototyped into hemostatic granules and dressing for application to control bleeding in traumatic wounds. Both hemostats have high clotting capability, no cytotoxicity and acute systemic toxicity, non-irritant and are weak dermal sensitizer. Pre-clinical studies demonstrated faster and more effective clotting in four, moderate to severe, animal bleeding models resulting to higher survivability rate compared to commercial hemostats. The prototypes are ready for clinical trials. Radiation-processed cassava/acrylic acid super water absorbent was developed that effectively retains water in clay-rich and sandy loam soils. Microbial degradation, phytotoxicity, genotoxicity showed biodegradability and safety of SWA for agricultural use. The use of SWA can save irrigation water and resources based on pot and field trials. Cost benefit analysis can improve farmer's productivity, especially during drought season.
Thailand	Results from the field tests, performed for two seasons, revealed that the SWA beads with uniform shape were prepared by spherification technique. The new process consumed less monomer and can reuse the monomer. The swelling ratio of beads was more than two times compared to the original methods. Field-tested SWA made from sugarcane bagasse on sugarcane plants with the cooperation of a sugar producing company were done. The field results showed an increase in the yield by up to 52%.
Viet Nam	SeNPs with a size of 41.8 nm were synthesized by γ-irradiation using oligochitosan (OCS) as the stabilizer. Compared to OCS, SeNPs/OCS exhibited a higher recovery for the total WBCs. Addition, SeNPs/OCS exhibited a good immune stimulation effect with a suitable 1.0–2.0 mg/kg feed concentration. Hydrogel scaffolds from gelatin/CM-chitosan and gelatin/CM-chitin prepared by radiation-crosslinking in combination with freeze-drying and radiation sterilization. Environmental Remediation: Real dyeing wastewater was degraded mostly by the electron beam method at a dose of 1 kGy and 1 mM H2O2, combined with biological treatment (selected strains from textile wastewater).