BIOFERTILIZERS R&D, REGULATIONS AND POLICY IN MALAYSIA

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INTRODUCTION

In the early years of developing the agricultural sector, Malaysia has relied heavily on conventional methods to produce, increase and sustain food production (Faridah, 2001). Malaysia considered agriculture as one of its most important economic sector. In 2016, agriculture sector stood at 8.1 per cent or RM89.5 billion to the Gross Domestic Product (GDP). Oil palm was a major contributor to the GDP of agriculture sector at 43.1 per cent followed by other agriculture (19.5%), livestock (11.6%), fishing (11.5%), forestry & logging (7.2%) and rubber (7.1 %). With 7.84 m ha of cultivated area in 2014, this industry plays an important role in ensuring food security, generating export revenue, creating agro-based industries and generating millions of job opportunities for Malaysian (DOA, 2015).

Realizing the importance of this sector, through its Economic Transformation Programme, the Malaysian Government recognized agriculture and plantation sectors as country’s National Key Economic Area (NKEA). NKEA is defined as an important driver of economic activities that potentially and directly contributes towards Malaysia’s economic growth measureable by the gross national income (GNI) indicator (Pemandu, 2011). Intensive agriculture in Malaysia is highly based on the usage of agricultural inputs such as fertilizers and pesticides. Both the agriculture and plantation sectors are operated by using imported fertilizers. In 2013, the amount of fertilizer imported were 3.95 million and 122,885 tonnes, respectively (DOA, 2016; FAO, 2016). The biggest portion of the production cost on agricultural and plantation crops goes to fertilizer purchase. Since these agro-inputs are imported, the fluctuating US dollar exchange value will burden both the sectors and increases the production cost. Reduction in production and threat of war in the main oil-producing regions had a deleterious impact on the fertilizer industry and ultimately agricultural production. Depletion of oil reserves, rising prices, environmental issues and the global greenhouse crisis has further affected this industry with tremendous rise in fertilizer prices. An injudicious usage of the input in agricultural sectors has created many environmental and health issues. Phenomenon such as soil hardening, increased soil salinity, low nutrient release capacity and low water holding capacity are very common when chemical fertilizers are used extensively, thereby contributing to poor nutrient use efficiency (NUE).

The consecutive use of fertilizers also disturbs the equilibrium of agro-systems and pollutes the environment. Over application of chemical fertilizers can result in negative effects such as leaching, pollution of water resources, destruction of micro-organism, crop susceptibility to diseases attack, acidification or alkalization of the soil or reduction in soil fertility, thus causing irreparable damage to the overall system.

A possible solution to avoid this fertilizer crisis especially towards to environment may rest with groups of microorganisms that have the capacity to provide the nutrients needed for crops and can-currently can reduced environmental pollutions.

However, in recent years responding to environmental issues, the nation is steadily adopting sustainable agricultural practises. Enhancement of biodiversity and agrowaste management are the approaches towards sustainability. This can be implemented by introducing integrated agriculture, with main emphasis on organic farming and use of organic matter, composting, conservation measure and production of organic fertilizers using the available agricultural waste. Soil enhancers in the form of compost, indigenous microbes and enzymes from natural farming technology; effective microbes and Arbuscular-mycorrhizal fungi are all the alternatives that are presently being used. Several 14 states in Malaysia have reported increased plant growth, weight and sizes of plants, using these soil-enhancing technologies. The effective microbe (EM) technology brought from Japan, which makes use of isolated groups of specific microbes such as photosynthetic bacteria, lactic acid bacteria and yeasts, is currently being practised in many states of Malaysia, including Sarawak (Zakaria, 2006).

There is a great potential for the biofertilizer industry in Malaysia, producing products from local sources and natural resources. However most of the microbial inoculants available in the market are imported. Therefore for quarantine purpose the Ministry of Agriculture advocates the production of EM for biofertilizer, using selected local microorganisms (Zakaria, 2006). In Malaysia, mycorrhizal products are perceived to be more versatile than others and therefore it has greatly appealed to the agricultural industry. Nevertheless, there is also
a good potential for biofertilizer products based on Azorhizobium and Azospirillum. 15 Effective microorganisms that have the ability to degrade fat, lignin, cellulose and hemicelluloses are given priority while preparing the inoculum specifically for the EFB substrates. But there is always a challenge with microbial products and hence research in the field of effective microbes will enhance biofertilizer use in the country. Therefore, in the current attempt to make the agriculture industry in Malaysia a viable component of a healthy and pleasant ecosystem, the use of biofertilizer and other microbial products is very crucial.

**BIOFERTILIZER**

The most promising strategy to reach the goal of sustainable agriculture, is to substitute hazardous agrochemicals with environment-friendly preparations for symbiotic microbes which could improve the nutrition of crops and livestock, as well as their protection from biotic (pathogens, pests) and abiotic (including pollution and climate change) stresses. Consequently, biofertilizers have emerged as one of the alternatives for transition towards more sustainable development pathways through biological nitrogen fixation (BNF) and have become important components of integrated nutrient management. According to the definition proposed by Vessey (2003), biofertilizer is a substance which contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Research in the field of biofertilizer has resulted in the development of different kinds of microbial inoculant or biofertilizers such as nitrogen fixing bacteria, phosphate solubilizing microorganism, vesicular-arbuscular mycorrhizae (VAM) and PGPR. Moreover, studies on the interaction between plant, soil and the different microorganisms have shed light on their inter-relationships thus providing new possible ways to exploit them for agricultural purposes.

Biofertilizers are now being increasingly used as a part of Integrated Plant Nutrient System (IPNS) that advocate involving a combination of 8 fertilizers, organic manures and microbial inoculants which are imperative to sustain crop production and maintain soil health and soil diversity in the long run. The use of BNF technology for maintenance of soil health and sustainable agriculture can be an alternate to chemical fertilizer. The main and direct purposes of applying biofertilizers to the soil are: to provide nutrient sources and good soil conditions for the growths of crops when used as a live body; to partially substitute and enhance the function of chemical fertilizer and then subdue the application quantities of fertilizers and still maintain the same crop yields and the capital used for making bio-fertilizers is cheaper than that of chemical fertilizers and to lessen the negative effect aroused from applying chemical fertilizers to soil. Biofertilizers promote the plant growth by supplying nutrients through atmospheric nitrogen fixation, phosphorus solubilisation and mobilization, potassium solubilisation and chelation of trace elements such as iron (Fe3+). Application of biofertilizers with minimal level of chemical nutrient input will attribute to better harvest. Chen et al. (2007) also stated that, the indirect purposes of using bio-fertilizers to soil are: to enhance the growth of root system to increase the water and nutrient absorption abilities of crops, extend the life of root, neutralize and degrade harmful materials accumulated in soil, promote survival efficiency of seedling after transplanting and get shorter time for the flower to come out. Thus the manifold advantages of biofertilizer leads to its wide applicability in sustainable agriculture. The success of biofertilizer depends on several factors, such as selecting the most effective microbial strain, seeking optimum conditions for its growth, formulation of the inocula and the method of its application (Bashan, 1998).

**Plant Growth Promoting Rhizobacteria (PGPR)**

Most of the bacteria included in biofertilizer have close relationship with plant roots. Rhizobium has symbiotic interaction with legume roots and rhizobacteria inhabit on root surface or rhizosphere of soil (Forum for Nuclear Cooperation in Asia [FNCA], 2006). These species of soil bacteria flourish in the rhizosphere of plants, may grow in, on, or around plant tissues and stimulate plant growth. They are collectively known as PGPR and among them are strains from genera such as Alcaligenes, Acinetobacter, Arthrobacter, Azospirillum, Bacillus, Burkholderia, Enterobacter, Erwinia, Flavobacterium, Paenibacillus, Pseudomonas, Rhizobium, and Serratia (Sharma et al., 2011). PGPR have been reported to directly enhance plant growth by a variety of mechanisms: fixation of atmospheric nitrogen, solubilisation of minerals such as phosphorus, production of siderophores, and synthesis of plant growth hormones i.e. Indole-3- acetic acid (IAA), gibberellic acid, cytokinins, and ethylene. Indirect mechanisms involves the biological control of plant pathogens and deleterious microbes, through the production of antibiotics, lytic enzymes, hydrogen cyanide, catalase and siderophore or through competition for nutrients and space 11 can improve significantly plant health.
and promote growth, as evidenced by increases in seedling emergence, vigour, and yield (Khan, 2006 as cited by Kumar et al., 2012). A range of PGPR have shown their ability to significantly increase the vegetative growth and grain yield of crop plants like rice, wheat, maize, sugarcane and cotton.

**Nitrogen Fixing Bacteria (NFB)**

Nitrogen which is one of the major nutrients required for the growth of crops is often limited. Bacteria mediate fixation of nitrogen at temperature and pressure enzymatically, by a process known as biological nitrogen fixation (BNF) (Brahmaprakash & Sahu, 2012). Nitrogen-fixing bacteria (NFB) transforms inert atmospheric N2 to organic compounds; and are grouped into free-living bacteria (Azotobacter and Azospirillum) and the blue green algae and symbionts such as Rhizobium, Frankia and Azolla. Biological nitrogen fixation by prokaryotes is a beneficial process in returning nitrogen to the soil towards crop production and leading to sustainable nutrient management. Nitrogen-fixing bacteria of Azotobacter and Azospirillum genera have been widely tested to increase yield of cereals and legumes under field conditions. Azolla biofertilizer were used for rice cultivation in different countries such as Vietnam, China, Thailand and Philippines; and the field trials indicated that rice yields increased by 0.5-2 t/ha (Gupta, 2004 as cited by Mohammadi & Sohrabi, 2012). According to Mohammadi and Sohrabi (2012), co-inoculation of some Pseudomonas and Bacillus strains along with effective Rhizobium spp. has shown to stimulate chickpea growth, nodulation and nitrogen fixation.

**Phosphate Solubilizing Bacteria (PSB)**

After nitrogen fixation, phosphate solubilisation is a very important plant growth promoting activity. Several soil bacteria particularly belonging to genera Bacillus and Pseudomonas, possess the ability to change insoluble forms into soluble form by secreting organic acids as formic acid, acidic, propionic, lactic, glycolic, fumaric and succinic acid (Vazquez et al., 2000). Phosphorus solubilizing bacteria play an important role in phosphorus nutrition by enhancing its availability to plants through the release from inorganic and organic soil phosphorous pools, by solubilisation and mineralization. Crop plants such as peanut, various horticultural plants and vegetables were successfully inoculated with PSBs to obtain higher yields. PSB such as Pseudomonas spp. enhanced the number of nodules, dry weight of nodules, yield components, grain yield, nutrient availability and uptake in soybean crop (Sharma et al., 2011). Several field experiments concluded that PSBs not only improved the growth and quality of crops but also drastically reduced the usage (by 1/3-1/2) of chemical or organic fertilizers (Chien et al., 2007). Phosphate solubilizing bacteria enhanced the seedling length of Cicer arietinum while co-inoculation of PSM and PGPR reduced phosphorous application by 50 % without affecting corn yield.

**QUALITY CONTROL OF BIOFERTILIZER**

Like every product, the biofertilizers should also follow some standards. The inoculants should be increases the storage or shelf life. Carriers which are used for making solid type of biofertilizer products are clay mineral, diatomaceous soil, and white carbon as mineral; rice, wheat bran, peat, lignite, peat soil, humus, wood charcoal and discarded feed as organic matter. However, clay mineral and rice bran are most often used as carriers. To achieve the tight coating of inoculant on seed surface, use of adhesive, such as gum arabic, methylethyl cellulos and vegetable oil is also available.

**MODE OF ACTION OF BIOFERTILIZER**

They fix nitrogen in the soil and the root nodules of the legumes crop and make it available to the plant. They solubilise the insoluble form of the phosphate like tricalcium, iron and aluminium phosphate into the available form. They produce hormones and anti metabolites which promote root growth. They also decompose the organic matter. When biofertilizers are applied to the seed and the soil they increases the availability of the nutrient to the plant and increases the yield up to 10-20% without producing any adverse effect to the environment. Therefore, significantly increase the plant growth parameters viz., plant height, number of
branches, number of roots, root length, shoot length, dry matter accumulation in plant organs and vigour index etc. (Ezz El-Din and Hendawy, 2010).

**ROLE OF BIOFERTILIZER IN AGRICULTURE**

The biofertilizers play an important role in improving the fertility of the soil. In addition, their application in soil improves the structure of the soil minimizes the sole use of chemical fertilizers. Under low land conditions, the application of BGA + Azospirillum proved significantly beneficial in improving LAI. Grain yield and harvest index also increase with use of biofertilizers. Inoculation with Azotobacter + Rhizobium + VAM gave the highest increase in straw and grain yield of wheat plants with rock phosphate as a P fertilizer. Azolla is inexpensive, economical, friendly, which provide benefit in terms of carbon and nitrogen enrichment of soil. Some commercially available biofertilizers are also used for the crop. Microorganisms (B.subtilis, Thiobacillus thioxidans and Saccharomyces sp.) can be used as bio-fertilizers for solubilization of fixed micronutrients like zinc. Soybean plants, like many other legumes can fix atmospheric nitrogen symbiotically and about 80 to 90% nitrogen demand could be supplied by soybean through symbiosis (Bieranvand et al., 2003). Bio-control, a modern approach of disease management can play a significant role in agriculture. Trichoderma based BAU-biofungicide has been found promising to control root knot diseases of French bean. Use of antagonist bacteria like Rhizobium and Bradyrhizobium also has significant effect in controlling root knot of mungbean (Khan et al., 2006). Growth, yield and quality parameters of certain plants significantly increased with biofertilizers containing bacterial nitrogen fixer, phosphate and potassium solubilizing bacteria and microbial strains of some bacteria.

**LIMITATION OF BIOFERTILIZER**

There are limitations in biofertilizers including:

i. Biofertilizers never mix with the chemical fertilizers
ii. Biofertilizers are never applied with the fungicides, plant ash at a same time
iii. Biofertilizers are never exposed to direct sunlight
iv. Stored at room temperature not below 0 and 35°C.

**BIOFERTILIZER R&D IN MALAYSIA**

Although there are plenty of good testimonies about the performance of biofertilizer in controlled environments in Malaysia, its performance in the field was inconsistent. Therefore, more intensive research are needed to develop biofertilizer products with excellent and reliable quality. In the past decades, at least 45 research projects were conducted by universities and public research institute (PRIs) in Malaysia (Table 1). The main bacterial genera studied for biofertilizer research are Bacillus, Klebsiella, Pseudomonas, Azospirillum, Rhizobium, Stenotrophomonas, Burkholderia, Sphingomonas, Arthrobacter and mycorrhizal fungi. Among them, the most studied microorganisms are Bacillus and mycorrhiza. The main crops studied for biofertilizer research were oil palm, rice, fruits and vegetables. Among them, oil palm and rice are prominent, since they are planted in large cultivated area. The main areas of focus were biofertilizer strain bioprospections, N-fixation, P and K solubilisation, root colonization and biofertilizer efficacy testing. However, another important research area in biofertilizers which was less investigated was bioremediation, which indicating the usage of biofertilizers for bioremediation is getting less attention in Malaysia. Most of soil bioremediation works conducted in Malaysia are mainly based on organic fertilizer and other synthetic chelating. There is a huge number of industry-sponsored biofertilizer researches conducted by universities and PRIs for testing the efficacy of their imported biofertilizer products. Product efficacy trials are crucial for testing the suitability and survival of industrial products in native conditions.
Table 1. Biofertilizer researches conducted in Malaysian PRIs and universities

<table>
<thead>
<tr>
<th>INSTITUTION</th>
<th>MICROORGANISM</th>
<th>FIELD OF STUDY</th>
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<tbody>
<tr>
<td>MARDI</td>
<td>Bacillus spp., Klebsiella spp., Pseudomonas aeruginosa, P. fluorescens, A. brasiliense Sp245, Rhizobium leguminosarum bv. trifolii R4, mycorrhiza</td>
<td>PGPR survival, K solubilisation, microbial activity at community level, physiology, PGPR counting, whole-genome expression, quality control of biofertiliser products</td>
</tr>
<tr>
<td>Universiti Putra Malaysia (UPM)</td>
<td>Bacillus spp., Stenotrophomonas, Burkholderia spp., Sphingomonas spp., Azospirillum brasiliense Sp7, Bacillus sphaericus UPMB10, mycorrhiza</td>
<td>Efficacy test, Plant growth promotion, root colonisation pattern, Bioprospection of PGPR, Nfixation, P-solubilisation</td>
</tr>
<tr>
<td>Universiti Kebangsaan Malaysia (UKM)</td>
<td>Sphingomonas paucimobilis, Arthrobacter globiformis, Bacillus cereus, Bacillus pumilus, Rhizobium rhizogenes, Rhizobium radiobacter</td>
<td>Bioremediation</td>
</tr>
<tr>
<td>Malaysian Nuclear Agency</td>
<td>Phosphate-solubilising bacteria, Mycorrhiza</td>
<td>Plant growth promotion, quality control of biofertiliser products, solid media sterilisation using gamma irradiation</td>
</tr>
<tr>
<td>University Malaya (UM)</td>
<td>Pseudomonas sp.</td>
<td>Genomic</td>
</tr>
<tr>
<td>Universiti Malaysia Sarawak (UNIMAS)</td>
<td>Bacillus spp.</td>
<td>Plant growth promotion</td>
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INDUSTRIAL DEVELOPMENT OF BIOFERTILIZERS

Biofertilizers marketed in Malaysia are either manufactured locally or imported. Currently, there are 44 biofertilizer products in the market sold by 22 suppliers (Table 3). Biofertilizers sold in this country can be categorised as bacterial and fungal based. Mycorrhiza is the main fungal-based biofertilizers available in the market. The bacterial-based biofertilizers contain various plant growth-promoting bacteria, mainly from the *Bacillus* genus. The bacterial-based biofertilizers are formulated using either single strain or multi-strains.

The bacterial-based biofertilizers are mainly in the liquid and wettable solid forms. Fungal-based biofertilizers product is available in solid form. The number of wettable freeze-dried microbial products is also increasing as it is convenient, easy and cheaper for transportation. There are also solid biochemical fertilizer cum biopesticide which are formulated by combining inorganic nutrients, organic fertilizer and biofertilizers and biopesticides. All Cosmos Industries Sdn. Bhd. is the prominent biochemical fertilizer manufacturer in the country where the production technology was transferred to Malaysia from Taiwan (Real Strong Max 99 and Max K). There is also biochemical fertilizer products (Real Strong MPOB F4 and Gano EF) which were formulated by technologies transferred to All Cosmos Industries Sdn. Bhd. by the local PRIs. The biofertilizers available in the Malaysian market are mainly for plantation crop (oil palm and rubber), rice, fruit and vegetable production. The main target of the product suppliers are on plantation crops and rice.

Table 2. Biofertilizers sold in Malaysia market
<table>
<thead>
<tr>
<th>SUPPLIER</th>
<th>PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Cosmos Industries Sdn Bhd</td>
<td>Real Strong brand: MPOB F4, Gano EF, Max 99, Max K</td>
</tr>
<tr>
<td>Agricultural Chemicals (M) Sdn. Bhd.</td>
<td>Deliver</td>
</tr>
<tr>
<td>Bio-S</td>
<td>Bio-S organic Fertilizer</td>
</tr>
<tr>
<td>Osaka Marketing (M) Sdn. Bhd.</td>
<td>Master Bio Fertilizer</td>
</tr>
<tr>
<td>EMRO Malaysia Sdn. Bhd.</td>
<td>EM 1</td>
</tr>
<tr>
<td>EQ Resources</td>
<td>EQ Turbo Solution</td>
</tr>
<tr>
<td>Biotrack Sdn. Bhd.</td>
<td>RhizaGold</td>
</tr>
<tr>
<td>PhytoGold Sdn. Bhd.</td>
<td>Bacto 10</td>
</tr>
<tr>
<td>IBG Manufacturing Sdn. Bhd.</td>
<td>IBG Oil Palm Biofertilizer, IBG Multi-Purpose Biofertilizer</td>
</tr>
<tr>
<td>LKB Biofertilizer</td>
<td>Warisan Microbiological Fertilizer</td>
</tr>
<tr>
<td>PR Biotech Marketing Ent.</td>
<td>Bomo Super</td>
</tr>
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**REGISTRATION PROCESS OF BIOFERTILIZERS AND AUTHORITIES UNIT IN MALAYSIA**

Biofertilizers available in the country are produced locally or imported. Currently there is no permit required for marketing of locally manufactured biofertilizer. However, import permit is compulsory for marketing of imported products. There are two types of permits required for microbial product importation and marketing: (i) Permit to import sample; for sample importation for related authority analysis (small consignment up to 2 kg or 2 l) (ii) Import permit; for bulk consignment importation for marketing. Permit to import sample can be applied by using an off-module (non-electronic) application. Off module application can be applied for the reasons given below: (i) Personal materials and sample owner (personal effects) (ii) Department/government agencies (iii) Participants of exhibitions (iv) Researcher / students (v) Materials imported for first time. For this application, applicants have to enclose a verification letter from organiser or related party. Application can be submitted to Crop Protection and Quarantine Section, Department of Agriculture of Malaysia (JPK) by filling the off-module import permit application form (EP-4A Form) and enclose a banker’s draft, postal order or money order valued RM 15.00 and paid to the Director General of Agriculture. Incomplete EP-4A Form will be rejected by the authority. Applicants are requested to apply for the permit 30 days before the importation of microbial product samples. The information requested in the EP-4A form is as listed below: 1. Importer name and address. 2. Telephone no. /fax no. 3. Exporter name and address. 4. Fertilizer/product commercial name. 5. Raw material blends with fertilizer/product (e.g. animal dung, sugarcane waste, paddy husk and others). 6. Microorganism (bacteria, fungus and others scientific name) blends with fertilizer/product. (Please enclose certified letter from manufacturer if the fertilizer does not contain any microorganism). 7. Lab procedure or protocol in the process of microorganism existence in the fertilizer/product. 8. Declaration from responsible authority (government authority) that the fertilizer/product does not contain any ingredients which can cause harmful effect to any plant, livestock, fish, human and environment. 9. NPK content (such as nitrogen 8 %, phosphorus 10 %, potash 7 % – if applicable). 10. Mineral (such as manganese, iron; if applicable). 11. Others (if applicable). 12. Manufacturing process of fertilizer/product (flowchart enclosed). 13. Fertilizer/product form (solid substance/liquid/granule). 14. Country of manufacturer. 15. Other countries using this fertilizer/product. 16. Purpose for using the fertilizer/product (e.g. root growth). 17. Fertilizer/product effect on plants. 18. Fertilizer/product effect on livestock. 19. Fertilizer/product effect on human and environment. For the materials that are imported in for the first time, the amount of organic fertilizer, microorganisms and materials containing microorganism allowed is 2 l, 2 kg or 5 units per samples (test tubes/ampoules) for analytical purposes. For importing sample, the entry point will only be the Kuala Lumpur International Airport (KLIA). Applicant has to pay RM 340.00 by using the method mentioned above as analysis fee for the samples. Five sets of the biofertilizers and biopesticide samples, each weighing 250 g (powder/solid) or 250 ml (liquid), need to be submitted during application.
Analysis will be conducted by four government agencies, viz. Department of Agriculture, Department of Fisheries, Department of Veterinary Services and Institute of Medical Research, to ensure that the item will not endanger plants, fish, livestock, humans and environment. The analysis results of the products will be presented to the Committee for Microorganisms Importation (MOBO). The committee consists of representatives from 17 Government agencies which will evaluate the products safety and risk for importation. If there is no objection from the committee member, the product import will be permitted by release of Permit to Import Plants/Soil/Rooting Compost/ Growing Media/Beneficial Organism/Organic Fertilizer. If there is objection, the permit will be hold and more information about the products would be requested from the importer, or the committee will request the importer to submit new samples (five sets) for the second analysis. The importer has to bear the cost of RM 340.00. The second analysis results of the products will be presented again to MOBO. If the results are accepted by committee members without any objection, the permit will be released. But, if there is objection, the permit application will be rejected.

APPLICATION OF PERMIT TO IMPORT BIOFERTILISERS IN LARGE QUANTITY FOR COMMERCIAL

Any import and export of materials into Malaysia requires an import/export permit. The permit needs to be applied electronically (ePermit) through an appointed vendor Dagang Net Technologies Sdn. Bhd. (DNT). Importer, exporter, forwarding agent and individual including foreigner have to be registered with Dagang Net for ePermit access. Registration form can be downloaded (www.dagangnet.com) or obtained from DNT branches in the country. A registration fee of RM 500 applied for corporate company and RM 200 for Small and Medium Enterprises (SME). A fee of RM 200 is applied for annual renewal of ePermit. ePermit application for any import of organic fertilizers, biofertilizers, biopesticides, microorganism and material containing microorganisms is required to import sample as prerequisite for permit application from JPK, Department of Agriculture of Malaysia. Once the ePermit application is registered with DNT, the applicant needs to inform JPK to initiate the online application. The applicant is requested to open a deposit account to enable import/export permit online application using ePermit Deposit Form EP-1. The minimal amount needed for a deposit account opening is RM 150.00. Before the bulk consignment of biofertilizers and biopesticides arrives, the JPK personnel will visit the warehouse where the products will be stored. If the personnel is satisfied with the warehouse condition for storage, the import permit will be granted. The JPK personnel will also collect the samples from three consecutive bulk consignments of the product arrived and will be analysed again, and the results will be presented to the MOBO committee. If the analysis data shown there has any discrepancies, the import permit will be revoked.

POLICY OF BIOFERTILIZERS IN MALAYSIA

National Policy on Science, Technology and Innovation (NPSTI) was drafted to develop a scientifically advanced nation for socio-economic transformation and inclusive growth towards an innovation technology by 2020 (OECD, 2014). This policy is very important in providing guidelines and implementing the strategies for the country to achieve its mission of high-income nation status by 2020. One of the strategic thrusts to achieve this ambition is advancing scientific and social research, development and commercialization (R, D and C). This policy had changed the landscape of the R, D and C in Malaysia where public funding researches must generate technology that benefitted the country and generating income and job opportunities for public by commercialization. Biofertilizer researches in the country also have to comply with this policy where commercialization of the innovation was stressed.

On the other hand, the Malaysian Standard for Biofertilizer currently in the stage to finalised the draft by Department of Standard Malaysia. The draft of standard will be presented to public in this year (2018) before it will be included in Fertilizer Act of Malaysia. The Fertilizer Act will be hearing in Parliament of Malaysia by next year, 2019.

STRATEGIC ACTIONS TO PROMOTE DEVELOPMENT AND USE OF BIOFERTILIZER IN MALAYSIA

There are several strategic actions need to be taken in order to promote development and use of biofertilizers in Malaysia. Malaysia needs to double her investment on promotion of biofertilizers in agriculture. This should comprise support and incentives in terms of policy, procedures, farmer compensation, risk insurance, R&D, capacity building, knowledge based extension and other efforts to promote nutrient management systems. Other strategic actions are as follow:

i. Intensify efforts to develop more efficient products and technologies, and enhanced capability and capacity for the production, availability, access, refinement, promotion, adoption and assessment of
bio agents through participatory mode involving public and private sectors, self-help groups, farmers and other stakeholders.

ii. Increased emphasis on formulation research and development, particularly on the active material/organism-formulate/auxiliary/other ingredient(s), to yield standard and quality products with improved shelf and field life. Development of farmer friendly technologies be specifically focused and pursued.

iii. Promote indexing, cataloguing and documentation of products, technologies, indigenous folklore knowledge and other information, and have the data banks freely accessible for reference and use.

iv. Accelerate efforts towards out scaling of innovations through proper assessment, refinement and transfer of technologies and products to farmers and other stakeholders. Promote those technologies which help farmers produce bio inputs on their own farms using mostly the local ingredients.

v. Devise and adopt simple and need-based regulatory systems for bio products, including improved species/strains, individual organisms and/or microbial consortia.

vi. Create jointly and support Regional Network on Biofertilizers in the Asia Pacific region in order to promote partnership, knowledge sharing, capacity building, and other activities for focused promotion of these bio inputs, including their need-based integrated use along with the chemical fertilizers.

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